AFWL-TR-65-24

THE PUFF AND P PUFF COMPUTER PROGRAMS

Richard N. Brodie
Captain USAF

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TECHNICAL REPORT NO. AFWL-TR-65-24

Research and Technology Division
AIR FORCE WEAPONS LABORATORY
Air Force Systems Command
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FOREWORD

This report was prepared in support of Project 5710, Task 571015, Program Element 7.60.06.01.5.

Inclusive dates of research were January 1964 through February 1965. The report was submitted by the authors 23 February 1965.

The authors wish to thank Lt. Colonel Ralph H. Pennington for his direction and supervision in the preparation of this report.

This technical report has been reviewed and is approved.

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ABSTRACT

The report describes the one-dimensional Lagrangian hydrodynamics computer program, PUFF. The code is used primarily in the study of X-ray effects. In the past year it has been extensively revised and is now quite different from versions used outside the Air Force Weapons Laboratory. The major calculations in each subroutine are explained with a complete description of all input-output variables. Sample problems with the appropriate data deck are included to allow a user to become familiar with data arrangement and to check the program on his computer.

CONTENTS

SECTION I

INTRODUCTION

The purpose of this report is to provide users of the PUFF code with an explanation of the latest version of the program. Several sample problems are included so that the user may become familiar with data input procedures and, at the same time, calibrate the program for his machine. The sample problems were designed to demonstrate a variety of input conditions and should be examined only in that context.

PUFF is a one-dimensional Lagrangian hydrodynamics program used primarily in the study of X-ray effects. The code uses finite difference methods to solve the equations of hydrodynamics using slab geometry and assuming one-dimensional flow through a 1-centimeter-square pipe (reference 1). One may follow a pressure pulse which is propagated through a sample consisting of up to six separate materials. A grid or mesh is superimposed on the materials in the sample. The grid areas are called zones and the grid lines are called zone boundaries. The mesh is numbered, increasing from left to right. The pressure pulse normally starts from the left and progresses through the mesh to the right. When we speak of the front of the mesh, we are referring to the larger zone numbers. When we speak of the back of the mesh, we are referring to the smaller zone numbers.

The index J is consistently used in the code to denote zone numbers. The materials in the sample are numbered consecutively from left to right. The index M is used when a material number is needed.

The original PUFF was a derivative of a Livermore code (reference 2). Extensive work on PUFF was done at the Air Force Weapons Laboratory and additional work was done under contract by McAllister and Associates, Inc. During this development the code became quite large for its degree of sophistication. Many options as to types of problems run were incorporated and an extremely complicated and time-consuming edit routine was developed. Since this development took place over a span of several years, many different

people made separate changes and no concentrated effort was made to delete options that were no longer used. This made the program almost impossible to use for one not intimately familiar with it.

In January of 1964 it was decided to make a version which would retain the essential elements of PUFF but eliminate all options which were not currently in use; and also to make the input-output as straightforward as possible. The monitor subroutine was eliminated and the edit routine was simplified by using the premise that it is more efficient to dump large amounts of required output on binary tape for later edit and plotting and to print only essential data during problem run time.

Since the code was designed to be driven by one of two dissimilar methods, flyer plate (plate slap) and energy deposition, it was decided that a considerable amount of computer time could be saved if the two options were handled in separate codes. The energy deposition code is now called PUFF and the plate slap code is called P PUFF. A great simplification in FORTRAN coding resulted from this division as well as a reduction in core space and computer time required. During this revision cgs units were incorporated and the equation of state was completely divorced from the hydro loop.

The present code consists of a main program where the hydrodynamics is accomplished and from which the other subroutines are called as needed. Each routine has been extensively rewritten and simplified with the exception of rezone where only minor corrections have been made.

PUFF and P PUFF are essentially the same except for the generator subroutines. The section dealing with the generator subroutine points out the major differences between the program.

SECTION II

MAIN PROGRAM

Variables and counters used only in the main program are initialized there instead of in the generator subroutine. Except for local variables being initialized, all calculations in the main program are contained in the time or cycle loop. The time loop begins with the main hydro loop. This loop starts with the first zone, advances in time all quantities associated with that zone, and proceeds with each zone in sequence until all zones have been advanced to the new time. After the hydro loop is completed, numerous checks are made to determine if the problem is complete, if a rezone is possible, or if one of the edit options is desired. If the problem is not complete, a new time step is calculated, the cycle counter N is advanced by 1, and a new cycle is started.

The velocity U, the ordinate of the zone boundary X, the specific volume V, and the artificial viscosity Q are computed in a standard Lagrangian manner. The pressure P, energy E, and sound speed CS are calculated by use of an interpolation method using values returned from an equation-of-state subrountine. This method was developed at the Air Force Weapons Laboratory and eliminates the requirement that the equation of state be in an analytic form.

A tentative time step is computed using the Courant condition modified for the use of artificial viscosity. The actual time step used is the minimum of the tentative time step, 120 percent of the old time step, or 1 one-hundredth of the energy deposit time.

The Lagrangian edit records the time-pressure history of the first zone in the material to the immediate right (downstream) of the chosen zone boundary. This edit is accomplished in the main program since it is exercised every cycle. The zone designated as a JEDIT is not allowed to collapse in rezone. Experience has shown it best not to designate consecutive zones as JEDITS unless one is very careful with the initial zone size.

SECTION III

GENERATOR

1. Introduction

The generator subroutine is called at the start of a problem to read all input data and initialize quantities needed in the problem. It is arranged in independent segments which are executed sequentially. All input values are printed out as a check of the data arrangement and for future reference.

The zoning for both PUFF and P PUFF is computed using a sequence of geometric progressions. This is accomplished using two sets of variables RZ and NZ. The RZs are the common ratios and the NZs are the zone indexes which terminate each progression.

The only essential difference in the generators of PUFF and P PUFF is that PUFF determines an energy deposit rate SS while P PUFF sets a velocity profile. These items are discussed below.

2. Energy Deposition (PUFF)

The absorption coefficients are computed using the formula

$$\mu = \rho \cdot AA \cdot (h \cdot \nu)^{B} \quad .$$

The values of AA and B are input numbers referenced to 1 kev that change with material and absorption edges.

One may use the energy spectrum obtained from a multiple black body source or may input an arbitrary spectrum. The arbitrary spectrum may be described by as many as 109 values of energy and corresponding $h \cdot \nu$ intervals. PUFF now uses 109 values of $h \cdot \nu / KT$ in the black body calculations instead of the 100 used in previous versions. This change was made to improve the high energy section of the curve. An energy deposit rate, SS, is computed for each zone using the above values in the standard exponential absorption formula.

3. Plate Slap (P PUFF)

P PUFF is designed to simulate the reactions caused by hitting a stationary plate with a piece of material (the flyer plate) moving at a given velocity

upon impact. The starting conditions for the problem simulate those at the instant of impact.

The velocity of each zone in the flyer plate, excluding the last, is set equal to the input variable UZERO. Provision is made to smear the velocity drop, from UZERO to ZERO, over five zones. The velocity of the first zone in the target is set at an input fraction (UFACE) of the flyer velocity. UFACE is used to match the acoustical impedances of the flyer plate and the target. It may be computed from $\text{UFACE} = \frac{Z_{FP}}{Z_{FP} + Z_T}$, where $Z = \rho_0 \cdot$ sound speed. The velocity in the last zone of the flyer plate is the average of the flyer plate velocity and the velocity of the first zone in the target. The velocity of the second zone in the target is one-half that of the first. A print of the calculated velocity profile is given.

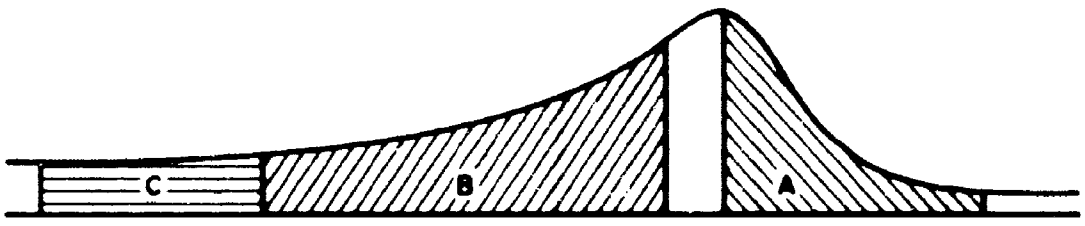
SECTION IV

REZONE

1. Introduction

At its best, rezone will introduce small perturbations in the solution. At its worst, rezone can completely destroy a problem. It is hoped that with judicious use the errors introduced will not affect the result by more than a few percent. The computer time saved is substantial.

The rezone routine was designed for a single pulse moving through a mesh having initial zone size increasing with zonal index. Since available computer time limits a problem to a few hundred zones, rezone tries to distribute the zones where they are most needed. The routine attempts to keep the resolution under the pulse constant by reducing zone size as the pressure peak approaches. Certain sections of the mesh are relatively inactive and will allow larger zone sizes. The collapse routine will combine two neighboring zones into one if certain conditions are met. The dividing and combining of zones is done in the divide and collapse routines respectively.



1st zone in mesh expanded less than 20%	1st zone left of max pressure having less than 2/10th max pressure	3rd zone to left of max pressure	zone of max pressure	20th zone in front of zone of max pressure

Figure 1. Rezone Regions

2. Divide Routine

The divide routine operates on twenty zones immediately in front of the zone of maximum pressure (region A, figure 1). To determine an appropriate size for a test zone, the positive momentum of the main pulse and the maximum pressure are used to construct a theoretical triangular pulse which is assumed to be moving with velocity equal to the sound speed of the zone of maximum pressure. The pulse length of this theoretical triangular pulse is found and divided by an input number, ZPUL. This distance is used as the "optimum" zone size in the region. Any zone larger than this check size is divided in half. The divided zone is then checked to see if it should be redivided.

3. Collapse Routine

The collapse routine combines adjoining zones in regions B and C in figure 1. Region B is assumed to be more active than C. Region B extends from three zones to the left of the zone having maximum pressure to the first zone to the left having a pressure less than two-tenths maximum pressure. Region C begins at the left boundary of B and extends to the first zone in the mesh which is expanded less than 20 percent, or to the first zone if no zone is expanded 20 percent. In region B the optimum zone size computed in the divide routine is multiplied by one-half the relative volume (ρ_0/ρ) of the zone of maximum pressure and this quantity is used for the optimum zone size in the region. Each zone in the region smaller than this check size is combined with an adjoining one. Region C uses a rather arbitrarily determined length for its zone size check. The length of the region is divided by the input variable JRZL and used as the optimum zone size. Each zone in the region smaller than this check size is combined with an adjoining zone. Zones designated as material boundaries or JEDITS are not collapsed. The collapse routine is presently entered only once every 100 cycles.

4. Comments

If one is interested in the back part of the mesh (reflected shocks, etc.) at later times, JRZL should be increased to something like 100. A JRZL of 20 will allow very large zones at late times which will effectively damp pulse movement. A ZPUL of 40 is adequate for most problems.

The divide routine may be bypassed in a problem by initializing ZPUL to zero. The collapse routine may be bypassed in a problem by initializing JRZL to zero.

SECTION V

EDIT

1. Introduction

Elaborate edit routines usually consume a sizable percentage of the computer time used by a problem. This fact leads to a conflict between obtaining sufficient edits to ensure adequate knowledge at all points of interest in the problem and the computer time that is available for the problem. Complicated edit routines also prove difficult in converting from one computer to another.

The present edit routine is divided into two parts. The first part stores, at designated intervals during the problem, all zonal variables and other selected variables on binary tape for later processing. The second part of the routine prints a sufficient number of key variables to enable the user to determine during run time that the problem is progressing satisfactorily, and, after problem completion, to determine points where more detailed edits are wanted. This method has the advantage of using the minimum amount of computer time while providing the maximum amount of available data. It has the disadvantage of requiring the user to wait longer for the final edits and plots.

The Air Force Weapons Laboratory uses the Cal Comp automatic plotter for most PUFF data presentation. The most commonly used plot program simply plots the pressure versus distance for a given time, although more complicated programs exist.

2. Output Variables

All variables printed in the edit routine are defined below.

N	Cycle number.
TIME	Present problem time.
DTNH	Present time step.
JSTAR	Zone number of the last zone in the mesh (from left to right) that has a velocity greater than 10^{-3} cm/sec.

PMAX	The maximum pressure contained in the mesh.
XJPMAX	Coordinate of the zone boundary of the zone having maximum pressure.
JPMAX	Zone number of the zone having the maximum pressure present in the mesh.
MVPULSE	Sum of the momentum of each zone from JPMAX+3 back to the first zone which as a negative velocity.
MVPREC	Sum of the momentum of each zone from JPMAX+4 out to JSTAR+1.
MOMENTUM	Sum of MVPULSE and MVPREC. This expression is computed by averaging the zone mass of two adjoining zones and using the velocity of the boundary between.
DTPP	Pulse width computed using the expression EMVPP/PMAX.
DTPULS	Pulse width computed using the expression EMVPL/PMAX.
ETOTAL	Total energy of the problem, computed by summing the kinetic and internal energy for each zone. The units are calories.
EMVNEG	Total negative momentum in the mesh. This expression is computed by averaging the velocities of two adjacent zone boundaries and using the zone mass of the zone between.
EMVPOS	Total positive momentum in the mesh. This expression is computed by averaging the velocities of two adjacent zone boundaries and using the zone mass of the zone between.
L-BOUND	Coordinate of the left material boundary (X(1)).

X(JBND1)	Coordinate of the boundary between the first and second material. It will be zero for one-material problems.
X(JBND2)	Coordinate of the boundary between the second and third material. It will be zero for two-material problems.
R-BOUND	Coordinate of the right material boundary.
JFIN	Zone number of the last zone in the problem.

SECTION VI

EQUATION OF STATE

1. Introduction

PUFF can now use any equation-of-state subroutine that will return a pressure when presented an energy, density, and material index.

The present equation of state is probably the greatest source of error in PUFF other than rezone. The pressure is computed using one of two functional equations: one for solid regions and one for vapor regions. If the zone is compressed relative to ambient conditions, the solid state equation is used. If the zone is expanded relative to ambient conditions, the vapor state equation is used.

2. Solid Phase

The solid phase equation is based on the Mie-Grüneisen equation of state (reference 3). This equation appears in PUFF as

$$P = C\mu + D\mu^2 + S\mu^3 + G\rho E \quad ,$$

where μ is ρ/ρ_0-1, G is the Grüneisen parameter and E is energy density. C is determined by the product of ambient density and the weak wave velocity squared. Each of the Hugoniot pressures is multiplied by the expression $(1 - \frac{G\cdot\mu}{2})$ and these points are least squares fit for D and S using C as a known parameter.

3. Vapor Phase

The vapor equation of state is a fit to the Thomas-Fermi-Dirac model in conjunction with a modified γ-law gas equation of state (reference 4).

The equation appears in PUFF as

$$P = n[H + (G-H)n^{1/2}]\ [E-E_S\{1-\exp\tfrac{N}{n}(1-\tfrac{1}{n})\}] \quad ,$$

where η is ρ/ρ_0, H is $(\gamma-1)$ effective for small η's, E_s is the sublimation energy, and N is determined from the expression

$$N = \frac{C}{G(E\cdot\rho_0)} \quad .$$

C, G, and E are defined above.

It is easy to show that the vapor and solid equations have a common limit of $G\rho E$ as the limits $\eta \to 1^-$ and $\eta \to 1^+$ are taken respectively.

4. Two-Wave Formulation

The most current version of PUFF contains an option for a two-wave structure in the solid phase equation. See figure 2.

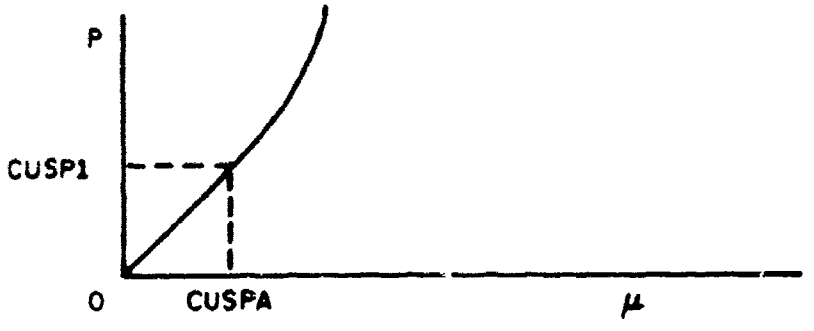


Figure 2. Two-Wave Structure

For μ's such that $0 \leq \mu \leq$ CUSPA, the pressure is computed by the normal solid equation. For μ's such that CUSPA $< \mu$, the pressure is computed using the expression

$$P = CUSP1 + C_1(\mu-CUSPA) + D_1(\mu-CUSPA)^2 + S_1(\mu-CUSPA)^3 + G\cdot\rho\cdot E \quad .$$

C_1 , D_1 , and S_1 are computed in the same manner as C , D , and S after translating the origin to the point (CUSPA, CUSP1).

SECTION VII

INPUT VARIABLES

This section gives a workable definition of all input variables used in both PUFF and P PUFF. Those followed with a number 1 are used only in PUFF. Those followed with a number 2 are used only in P PUFF. All other variables are common to both codes.

AA(M,I)	(1)	Constants used in computing absorption coefficients. The dimensions are cm^2/gm. See section on Generator subroutine.
ANGLE	(1)	Angle in degrees of the X-ray path measured from the normal of the material. A zero value indicates perpendicular alignment.
B (M,I)	(1)	Dimensionless constants used in computing absorption coefficients. See section on Generator subroutine.
CKP		A problem stop parameter. The problem will terminate when the maximum pressure reaches this distance in centimeters.
CUSPA(M)		$\mu, \frac{\rho}{\rho_0} - 1$, corresponding to an inflection point in the Hugoniot data.
CUSPC(M) CUSPD(M) CUSPS(M)		Equation-of-state constants used in the two-wave solid phase equation. The units are dynes/cm^2. See section on Equation of State.
CUSPG(M)		Grüneisen parameter for the two-wave solid phase equation. It is dimensionless.
CUSPI(M)		Value of the pressure in dynes/cm^2 corresponding to an inflection point in the Hugoniot data.

DISCPT		Description of the problem. Up to 80 permissible Hollerith characters may be used.
DX		Size of the first zone in centimeters.
EE(I)	(1)	Total energy in cal/cm^2 of each black body. For problems where ANGLE $\neq$ 0, the total energy for each black body should be multiplied by cos (ANGLE).
EDGE(M,I)	(1)	Values of $h \cdot \nu$ where the absorption coefficients are discontinuous.
EI(I)	(1)	Energy in cal/cm^2 corresponding to each interval of $h \cdot \nu$ in an arbitrary spectrum problem. For problems where ANGLE $\neq$ 0, each value of EI should be multiplied by cos (ANGLE). EI is computed in a black body problem.
EQSTC(M) EQSTD(M) EQSTS(M)		Equation-of-state constants used in the solid phase equation. The units are dynes/cm^2. See section on Equation of State.
EQSTE(M)		Sublimation energy of material M in ergs/gm.
EQSTG(M)		Grüneisen parameter. It is dimensionless.
EQSTH(M)		$(\gamma-1)$ effective for low values of ρ/ρ_0. It is dimensionless.
JBND(M)		Zone number of the last zone in a material (M). The JBND of the last material should be initialized as zero for the code, i.e., JBND (NMTRLS)=0. In a plate slap, if the flyer and target

		are the same material, the JBND(1) = JFIN2.
JCYCS		A problem stop parameter. The problem will terminate after running this many cycles.
JEDIT(I)		Zone number where Lagrangian edits are desired.
JFIN		Zone number of the last zone in the problem.
JRZL		Arbitrary number of zones desired in the collapse region of rezone. Should be 20 to 50 for one-pulse problems, 40 to 100 for two-pulse problems, and 20 to 100 for plate slap problems.
JZPUL		Zoning number used in rezone for dividing in front of the pulse. A value of 40 is good for all problems. ZPUL is set equal to JZPUL.
LOZHIZ	(1)	Flag used to allow use of rezone in a two-pulse problem. Set to zero for one-pulse problems. Set to 1 if the right pulse is predicted to be dominant in two-pulse problems.
MATL(M)		Material name or description.
NBB	(1)	Number of black bodies used. Should be 1 for an arbitrary spectrum problem
NHNU	(1)	Number of matched values of $h\cdot\nu$ intervals and energy used in the arbitrary spectrum input. If zero, used as a flag to select black body energy computation.

NJEDIT		Number of Lagrangian edits selected.
NMTRLS		Number of materials. In a plate slap, if the flyer and target are of the same material, then NMTRLS = 2.
NOE(M)	(1)	Number of edges (discontinuities in absorption coefficients) for each material.
NPRIN		Controls the frequency of printed edits. Edits will be printed at cycles which are integer multiples of this number.
NRZ		Number of zoning ratios used in initial zoning.
NTAPE		Controls frequency of data dumps on binary tape. Information will be stored at cycles which are integer multiples of this number.
NTEDT		Number of time edits selected.
NTEST		A read check variable. Should always be set to 30. If there are too few or too many data cards, the problem will stop.
NZ(I)		Zoning number which changes the zoning ratio (RZ). The code requires this number to be 1 less than the zone where the ratio is wished to be changed.
PMIN(M)		Minimum pressure in dynes/cm^2 allowed in the mesh for material M. Approximates the dynamic tensile strength.
RHO(M)		Ambient density in gm/cm^3 of the material M.
RZ(I)		Zoning ratio used in geometrically zoning a problem.

SDUR	(1)	X-ray shine time in seconds.
T(I)	(1)	Temperature in kev of each black body. May be read as zero in an arbitrary spectrum problem.
TBL(I)	(1)	Storage for $h \cdot \nu/KT$ values for black body problems or $h \cdot \nu$ values for arbitrary spectrum problems.
TEDIT(I)		Problem times in seconds where edits are desired.
TIME		First time step in seconds. This variable is later used for total problem time. 10^{-12} seconds is a reasonable figure for most problems.
TS		A problem stop parameter. The problem will terminate when TIME reaches this time in seconds.
UFACE	(2)	A constant used to smear the velocity discontinuity between the flyer and the target over five zones. See section on Generator.
UFIN	(2)	I ıst zone of the flyer plate.
UZERO	(2)	Velocity of the flyer plate.

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APPENDIX I

FORTRAN LISTING OF PUFF

```
      PROGRAM PUFF                                                          10
C     THIS IS PUFF FOR DEPOSITION ONLY FOR THL  AFWL 1604 *****             20
C                                                                           30
      COMMON AA(6,20),AC(10,109,6),B(6,20),CUSP1(6),CUSPA(6),CUSPC(6),      40
     1CUSPD(6),CUSPG(6),CUSPS(6),DISCPT(12),EE(10),EDGE(6,20),EI(10,109)    50
     2,EQSTC(6),EQSTD(6),EQSTE(6),EQSTG(6),EQSTH(6),EQSTN(6),EQSTS(6),      60
     3JBND(6),JEDIT(10),JORG(10),MATL(6),NOE(6),NZ(20),PMIN(6),RHO(6),      70
     4RZ(20),SS(801),T(10),TBL(109),TEDIT(25),X(801)                        80
C                                                                           90
      COMMON CKP,DTNH,DTN,JCK,JCYCS,JFIN,JPMAX,JPMAXI,JRZL,JSTAR,JXXO,JZ    100
     1PUL,LINE,LCZHIZ,N,NBB,NJEDIT,NMTRLS,NPRIN,NRZ,NTAPE,NTEDT,PMAX,       110
     2SDUR,TIME,TS,WTAPE,ZPUL                                               120
C                                                                           130
      DIMENSION P(1),Q(1),CS(1),E(1),V(1),ZM(1),U(1)                        140
C                                                                           150
      EQUIVALENCE (AC,P),(AC(802),Q),(AC(1603),CS),(AC(2404),E),(AC(3205    160
     1),V),(AC(4006),ZM),(AC(4807),U)                                       170
C                                                                           180
      ZEROES COMMON                                                         190
      DO 1 K=1,9954                                                         200
    1 AA(K)=0.                                                              210
      CALL GENRAT                                                           220
C                                                                           230
C             INITIALIZE  COUNTERS AND CONSTANTS                            240
C                                                                           250
      LINE=0                                                                260
      FLAG=0.                                                               270
      C0=1.8                                                                280
      C1=.25                                                                290
      TWOC1=2.*C1                                                           300
      COSQ=C0*C0                                                            310
      FORCSQ=4.*COSQ                                                        320
      II=1                                                                  330
      N=1                                                                   340
      SSCK=0.                                                               350
      DTN=TIME                                                              360
      DTNH=TIME                                                             370
      HYDRO STARTS HERE                                                     380
C                                   TIME LOOP                             390
C                                                                           400
      SK2M=0.                                                               410
      PMAX=0.                                                               420
      M=1                                                                   430
      LL=1                                                                  440
C     DETERMINE THE LEFT BOUNDARY CONDITIONS                                450
      U(1)=U(1)-DTN*(Q(2)+P(2))/ZM(2)                                       460
      X(1)=X(1)+DTNH*U(1)                                                   470
C                                                                           480
C             MAIN LOOP FOR HYDRO CALCULATION                               490
C                                                                           500
```

```
      JPINM1=JPIN-1                                                     910
      DO 44 J=1,JPINM1                                                  920
      VOLD=V(J+1)                                                       930
      QOLD=Q(J+1)                                                       940
      POLD=P(J+1)                                                       950
      IF (J+1-JBN(M)) 4,3,4                                             960
    3 LL=LL+1                                                           970
    4 IF (J-JTAR) 9,9,5                                                 980
    5 E(J+2)=MINIF(TIME-DTNH,S(J+2))*S(J+2)                             990
      IF(V(J+2)) 7,7,6                                                 1000
    6 EL=1./V(J+2)                                                     1010
      GO TO 8                                                          1020
    7 EL=0.                                                            1030
    8 CALL EQST (E(J+2),DEN,P(J+2),LL)                                 1040
    9 Q(J+1)=Q(J+1)-DTN*(P(J+2)+Q(J+2)-P(J+1)-Q(J+1))/(ZM(J+1)+ZM(J+2)) 1050
      IF(ABS(Q(J+1))-1.E-3) 10,10,11                                   1060
   10 Q(J+1)=0.                                                        1070
   11 X(J+1)=X(J+1)+DTNH*U(J+1)                                        1080
      DU=U(J+1)-U(J)                                                   1090
      V(J+1)=(X(J+1)-X(J))/ZM(J+1)                                     1100
      VAVG=(V(J+1)+VOLD)/2.0                                           1110
      DV=DTNH*DU/ZM(J+1)                                               1120
      IF (DU+1.) 12,13,13                                              1130
   12 U(J+1)=(DU*COSQ-C1*CS(J+1))*DU/VAVG                              1140
      IF (U(J+1)-1.) 13,14,14                                          1150
   13 Q(J+1)=0.                                                        1160
      DU=0.                                                            1170
      TS(J+1)=0.                                                       1180
   14 IF (TIME-SOUR) 18,15,16                                          1190
   15 P(J+1)=P(J+1)+SS(J+1)*DTNH                                       1200
      GO TO 18                                                         1210
   16 IF(SSCK) 18,17,18                                                1220
   17 E(J+1)=P(J+1)+SS(J+1)*(SOUR-(TIME-DTNH))                         1230
      SSCK=1.                                                          1240
   18 DNEW=1./V(J+1)                                                   1250
      DOLD=P(J+1)                                                      1260
      CALL EQST (E(J+1),DNEW,P2,M)                                     1270
      EL=E(J+1)-P(J+1)*EV                                              1280
      CALL EQST (EL,DNEW,P1,M)                                         1290
      P(J+1)=P2+(P(J+1)+Q(J+1)+QOLD)*DV/(2.-(P1-P2)/P(J+1))            1300
      P2=P2+(P2-P1)*(E(J+1)-EOLD)/(POLD-DV)                            1310
      DLTD=.001*DNEW                                                   1320
      IF (DV) 20,19,19                                                 1330
   19 DFUDG=DNEW+DLTD                                                  1340
      GO TO 21                                                         1350
   20 DFUDG=DNEW-DLTD                                                  1360
   21 CALL EQST (E(J+1),DFUDG,PFUDG,M)                                 1370
      DPDRHO=(PFUDG-P(J+1))/(DFUDG-DNEW)                               1380
      IF (DPDRHO) 22,22,23                                             1390
   22 SPEED=0.                                                         1400
      GO TO 24                                                         1410
   23 SPEED=SQRTF(DPDRHO)                                              1420
   24 SPDM1=(SPEED+TWOC1*CS(J+1)-FORCSQ*DU)/(X(J+1)-X(J))              1430
      CS(J+1)=SPEED                                                    1440
                                                                       1450
      IF (P(J+1)-PMAX) 26,26,25                                        1460
   25 PMAX=P(J+1)                                                      1470
```

```
      JPMAX=J+1                                                         1090
26    IF (SK2M-SK2M1) 27,27,28                                          1100
27    SK2M=SK2M1                                                        1110
28    M=LL                                                              1120
      IF (U(J+1)) 33,29,33                                              1130
29    IF (N-1) 30,30,31                                                 1140
30    JPMAX1=JPMAX+10                                                   1150
      IF(LOZHIZ) 31,32,31                                               1160
31    IF (J-JSTAR) 33,32,32                                             1170
32    JSTAR=J                                                           1180
      GO TO 34                                                          1190
33    CONTINUE                                                          1200
C                          MAIN LOOP ENDS HERE                        1210
C                                                                       1220
      JSTAR=JFINM1                                                      1230
C                                                                       1240
C     EXIT AND EDIT CONTROL                                             1250
C                                                                       1260
34    IF (TIME-TS) 35,37,37                                             1270
35    IF (N-JCYCS) 36,37,37                                             1280
36    IF (X(JPMAX)-CKP) 41,37,37                                        1290
37    FLAG=1.                                                           1300
38    WTAPE=1.                                                          1310
      CALL EDIT                                                         1320
      END FILE 4                                                        1330
      END FILE 6                                                        1340
      REWIND 4                                                          1350
      REWIND 6                                                          1360
      IF(FLAG) 39,40,39                                                 1370
39    REWIND 45                                                         1380
      STOP                                                              1390
40    CALL DOTF                                                         1400
      PAUSE                                                             1410
41    IF (SENSE SWITCH 2) 42,44                                         1420
42    PRINT 43,N                                                        1430
43    FORMAT (31H SENSE SWITCH 2 IS ON AT CYCLE I10)                    1440
      GO TO 38                                                          1450
44    IF(XMODF(N,NTAPE)) 46,45,46                                       1460
45    WTAPE=1.                                                          1470
      CALL EDIT                                                         1480
      GO TO 48                                                          1490
46    IF(XMODF(N,NPRIN)) 48,47,48                                       1500
47    WTAPE=1.                                                          1510
      CALL EDIT                                                         1520
C                                CYCLE ADVANCE                        1530
C                                                                       1540
48    SK2M=MINF(.9/SK2M,1.2*DTNH)                                       1550
      IF(NJEDIT) 49,51,49                                               1560
49    WRITE TAPE 4,NJEDIT,N,TIME                                        1570
      DO 50 I=1,NJEDIT                                                  1580
      JB=JEDIT(I)                                                       1590
50    WRITE TAPE 4,JORG(I),JFDIT(I),P(JB+1)                             1600
51    IF(SDUR-TIME) 53,53,52                                            1610
52    SK2M=MINF(.01*SDUR,SK2M)                                          1620
53    DTN=DTNH                                                          1630
      DTNH=SK2M                                                         1640
      CALL RETONE                                                       1650
```

```
      IF (TEDIT(III)) 58,58,54                                          1650
54    IF (NTEDT) 55,57,55                                               1660
55    IF (TIME+DTNH-TEDIT(III)) 58,58,56                                1670
56    DTNH=TEDIT(III)-TIME                                              1680
      NTEDT=0                                                           1690
      GO TO 58                                                          1700
57    WTAPE=1.                                                          1710
      CALL EDIT                                                         1720
      III=III+1                                                         1730
      NTEDT=1                                                           1740
58    TIME=TIME+DTNH                                                    1750
      DTN=DTN+DTNH                                                      1760
      N=N+1                                                             1770
      IF (DTNH) 59,59,2                                                 1780
59    PAUSE25                                                           1790
      GO TO 2                                                           1800
      END                                                               1810
```

```
C     GENERATOR  SUBROUTINE FOR THE PUFF HYDRO CODE                      1820
C                                                                        1830
      SUBROUTINE GENRAT                                                  1840
C                                                                        1850
      COMMON AA(6,20),AC(10,109,6),B(6,20),CUSP1(6),CUSPA(6),CUSPC(6),   1860
     1CUSPD(6),CUSPG(6),CUSPS(6),DISCPT(12),EE(10),EDGE(6,20),EI(10,10   1870
     2,EQSTC(6),EQSTD(6),EQSTE(6),EQSTG(6),EQSTH(6),EQSTN(6),EQSTS(6),   1880
     3JBND(6),JEDIT(10),JORG(10),MATL(6),NOE(6),NZ(20),PMIN(6),RHO(6),   1890
     4RZ(20),SS(801),T(10),TBL(109),TEDIT(25),X(801)                     1900
C                                                                        1910
      COMMON CKP,DTNH,DTN,JCK,JCYCS,JFIN,JPMAX,JPMAX1,JRZL,JSTAR,JXXO,J7  1920
     1PUL,LINE,LOZHIZ,N,NBB,NJEDIT,NMTRLS,NPRIN,NRZ,NTAPE,NTEDT,PMAX,    1930
     2SDUR,TIME,TS,WTAPE,ZPUL                                            1940
C                                                                        1950
      DIMENSION P(1),Q(1),CS(1),E(1),V(1),ZM(1),U(1)                     1960
C                                                                        1970
      EQUIVALENCE (AC,P),(AC(802),Q),(AC(1603),CS),(AC(2404),E),(AC(320  1980
     1),V),(AC(4006),ZM),(AC(4807),U)                                    1990
C                                                                        2000
1     FORMAT(10A8)                                                       2010
2     FORMAT (8I10)                                                      2020
3     FORMAT (8E10.3)                                                    2030
4     FORMAT(2E15.7)                                                     2040
5     FORMAT(1H07HEITOT =E15.7)                                          2050
6     FORMAT(1H08HLOZHIZ =I10)                                           2060
7     FORMAT (45H ERROR--INPUT CARDS ARE NOT PROPERLY PREPARED)          2070
8     FORMAT (25H1INPUT PARAMETERS FOR - -/1HC10A8)                      2080
9     FORMAT(46H ***** THIS PROBLEM WAS RUN ON PUFF/1604 *****)          2090
10    FORMAT (13H TABLE VALUES/(10E10.3,/))                              2100
11    FORMAT (1H06X,3HNBB6X,4HNRZC4X,6HNMTRL36X,4HJRZL5X,5HJZPUL5X,5HNPR  2110
     1IN6X,5HANGLE/6I10,F10.3)                                           2120
12    FORMAT (//17H ZONING CONSTANTS//)                                  2130
13    FORMAT (3X,6H RA=10E10.3,8H TO ZONE16)                             2140
14    FORMAT (//45H BLACK BODY TEMPERATURE AND ASSOCIATED ENERGY)        2150
15    FORMAT (12H TEMPERATURE,5X,8H ENERGY )                             2160
16    FORMAT (1H E10.3,6X,E10.3)                                         2170
17    FORMAT (1H05X,4HJFIN5X,5HJCYCS5X,5HNTEDT5X,5HNTAPE7X,3HCKP6X,2HTS6  2180
     1X,4HTIME6X,4HSDUR/4I10,4E10.3)                                     2190
18    FORMAT (25HOMATERIAL PROPERTIES FOR A8,5X,4HRHO=E10.3,5X,7HFROM J=  2200
     1I5,2X,5HTO J=I5)                                                   2210
19    FORMAT (1H09X,5HEQSTC10X,5HEQSTD10X,5HEQSTE10X,5HEQSTG10X,5HEQSTH1  2220
     1 X,5HEQSTS10X,5HEQSTN11X,4HPMIN/8E15.5)                            2230
20    FORMAT(1H09X,5HCUSP110X,5HCUSPA10X,5HCUSPC10X,5HCUSPD10X,5HCUSPG    2240
     110X,5HCUSPS/6E15.5)                                                2250
21    FORMAT (///5H NOE=I5,23X,3H AA,16X,2H B,20X,5H EDGE//)             2260
22    FORMAT (E37.5,E20.5,E25.5)                                         2270
23    FORMAT(1H1,10A8,/5HO  J 6X,2HDX13X,1HX11X,4HERGS10X,3HCAL10X,      2280
     17HSUM CAL7X,7HERGS/GM7X,8HVELOCITY5X,9HZONE MASS4X,1HJ//)          2290
24    FORMAT (1H I3,8E14.5,I4)                                           2300
25    FORMAT (1H1)                                                       2310
26    FORMAT (1HC10X,14HTHE TEDITS ARE/10E10.3/)                         2320
27    FORMAT (1HC10X,14HTHE JEDITS ARE/10I10)                            2330
28    FORMAT (21H MATERIAL THICKNESS =E10.3)                             2340
C                                                                        2350
C                          READ DATA                                     2360
C                                                                        2370
C                                                                        2380
```

```
      READ 2,NHNU,NTEDT,NJEDIT,LOZHIZ                                    2400
      IF (NHNU) 29,30,29                                                 2410
29    READ 4,(TBL(I),EI(1,I),I=1,NHNU)                                   2420
      GO TO 31                                                           2430
30    READ 3,(TBL(I),I=1,109)                                            2440
31    READ 1,(DISCPT(I),I=1,10)                                          2450
      IF(NTEDT) 33,33,32                                                 2460
32    READ 3,(TEDIT(I),I=1,NTEDT)                                        2470
33    IF(NJEDIT) 35,35,34                                                2480
34    READ 2,(JEDIT(I),I=1,NJEDIT)                                       2490
35    READ 2,NBB,NRZC,NMTRLS,JRZL,JZPUL,NPRIN,NTAPE                      2500
      ZPUL=JZPUL                                                         2510
      READ 3,ANGLE                                                       2520
      NMT=NMTRLS-1                                                       2530
      READ 2,(NOE(M),M=1,NMTRLS)                                         2540
      READ 3,SOUR,(T(L),EF(L),L=1,NBB)                                   2550
      IF (NMT) 37,37,36                                                  2560
36    READ 2,(JBND(M),M=1,NMT)                                           2570
37    READ 2,JFIN,(NZ(L),L=1,NRZC)                                       2580
      READ 3,DX,TIME,(RZ(M),M=1,NRZC)                                    2590
      DX=DX/RZ(1)                                                        2600
      DO 38 M=1,NMTRLS                                                   2610
      READ 1,MATL(M)                                                     2620
      READ 3,RHO(M),EQSTC(M),EQSTD(M),EQSTE(M),EQSTG(M),EQSTH(M),EQSTS(M 2630
     1),PMIN(M)                                                          2640
      READ 3,CUSPI(M),CUSPA(M),CUSPC(M),CUSPD(M),CUSPG(M),CUSPS(M)       2650
      EQSTN(M)=EQSTC(M)/EQSTG(M)/(EQSTE(M)*RHO(M))                       2660
      NCED=NCE(M)                                                        2670
38    READ 3,(AA(M,I),B(M,I),EDGE(M,I),I=1,NCED)                         2680
      READ 3,CKP,TS                                                      2690
      READ 2,JCYCS,NTEST                                                 2700
      IF (NTEST-30) 39,40,39                                             2710
39    PRINT 7                                                            2720
      STOP                                                               2730
40    JCK=0                                                              2740
      JXXO=0                                                             2750
      NRZ=-5                                                             2760
      ANGLE=COSF(ANGLE/57.2957795)                                       2770
      IF(NJEDIT) 43,43,41                                                2780
41    DO 42 I=1,NJEDIT                                                   2790
42    JORG(I)=JEDIT(I)                                                   2800
C                                                                        2810
C                          CALCULATE ABSORPTION COEFFICIENTS             2820
C                                                                        2830
43    IF(NHNU) 44,50,44                                                  2840
44    DO 48 M=1,NMTRLS                                                   2850
      K=1                                                                2860
      DO 48 I=1,NHNU                                                     2870
45    IF (EDGE(M,K)-TBL(I)) 46,46,47                                     2880
46    K=K+1                                                              2890
      GO TO 45                                                           2900
47    AC(I,I,M)=-RHO(M)*AA(M,K)*(TBL(I)**B(M,K))/ANGLE                   2910
48    CONTINUE                                                           2920
      EITOT=0.                                                           2930
      DO 49 II=1,NHNU                                                    2940
49    EITOT=EITOT+EI(1,II)                                               2950
      GO TO 58
```

```
50    EITOT=0.                                                          2960
      DO 54 M=1,NMTRLS                                                  2970
      DO 54 L=1,NBB                                                     2980
      K=1                                                               2990
      DO 54 I=1,109                                                     3000
51    IF (EDGE(M,K)-TBL(I)*T(L)) 52,52,53                               3010
52    K=K+1                                                             3020
      GO TO 51                                                          3030
53    AC(L,I,M)=-RHO(M)*AA(M,K)*(TBL(I)*T(L))**B(M,K)/ANGLE             3040
54    CONTINUE                                                          3050
      DO 57 L=1,NBB                                                     3060
      DO 57 I=1,109                                                     3070
      IF (I-99) 55,55,56                                                3080
55    EI(L,I)=EE(L)*.01                                                 3090
      GO TO 57                                                          3100
56    EI(L,I)=EE(L)*.001                                                3110
57    CONTINUE                                                          3120
C                                                                       3130
C                    COMPUTE DX USING ZONEING CONSTANTS                 3140
C                                                                       3150
58    LZ=1                                                              3160
      DO 61 J=1,JFIN                                                    3170
      IF (J-1-NZ(LZ)) 60,59,60                                          3180
59    LZ=LZ+1                                                           3190
60    DX=DX*RZ(LZ)                                                      3200
61    X(J+1)=X(J)+DX                                                    3210
C                                                                       3220
C                      ZONE DEPOSITION                                  3230
C                                                                       3240
      M=1                                                               3250
      DO 71 J=1,JFIN                                                    3260
      ESUM=0.                                                           3270
      IF (J-JBND(M)) 63,62,63                                           3280
62    M=M+1                                                             3290
63    IF (NHNU) 64,67,64                                                3300
64    DO 66 I=1,NHNU                                                    3310
      IF (EI(1,I)-1.E-20) 66,65,65                                      3320
65    EIZ=EI(1,I)*(1.-EXPF(AC(1,I,M)*(X(J+1)-X(J))))                    3330
      EI(1,I)=EI(1,I)-EIZ                                               3340
      ESUM=ESUM+EIZ                                                     3350
66    CONTINUE                                                          3360
      GO TO 70                                                          3370
67    DO 69 L=1,NBB                                                     3380
      DO 69 I=1,109                                                     3390
      IF (EI(L,I)-1.E-20) 69,68,68                                      3400
68    EIZ=EI(L,I)*(1.-EXPF(AC(L,I,M)*(X(J+1)-X(J))))                    3410
      EI(L,I)=EI(L,I)-EIZ                                               3420
      ESUM=ESUM+EIZ                                                     3430
69    CONTINUE                                                          3440
70    SS(J+1)=ESUM*4.186E7/RHO(M)/(X(J+1)-X(J))/SDUR                    3450
      IF (SS(J+1)-1.E12/RHO(M)) 72,71,71                                3460
71    CONTINUE                                                          3470
C                                                                       3480
C                          CLEAR STORAGE TO ZERO FOR HYDRO              3490
C                                                                       3500
      DO 73 I=1,5608                                                    3510
73    AC(I)=0.                                                          3520
```

```
C                                                                       3530
C                          SET UP ZONING FOR HYDRO                      3540
C                                                                       3550
      M=1                                                               3560
      DO 75 J=2,JFIN                                                    3570
      V(J)=1./RHO(M)                                                    3580
      ZN(J)=(X(J)-X(J-1))/V(J)                                          3590
      IF (J-JBND(M)) 75,74,75                                           3600
74    M=M+1                                                             3610
75    CONTINUE                                                          3620
C                                                                       3630
C                          START INPUT EDIT                             3640
C                                                                       3650
      PRINT 4                                                           3660
      PRINT 1,(DISCPT(K),K=1,10)                                        3670
      PRINT 9                                                           3680
      PRINT 10,(TBL(I),I=1,109)                                         3690
      PRINT 11,NBB,NRZC,NMTRLS,JRZL,JZPUL,NPRIN,ANGLE                   3700
      PRINT 5,EITOT                                                     3710
      PRINT 6,LOZHIZ                                                    3720
      PRINT 12                                                          3730
      PRINT 13,(RZ(I),NZ(I),I=1,NRZC)                                   3740
      PRINT 14                                                          3750
      PRINT 15                                                          3760
      PRINT 16,(T(I),EE(I),I=1,NBB)                                     3770
      PRINT 17,JFIN,JCYCS,NTEST,NTAPE,CKP,TS,TIME,SDUR                  3780
      IF(NJEDIT) 77,77,76                                               3790
76    PRINT 27,(JEDIT(I),I=1,NJEDIT)                                    3800
77    IF(NTEDT) 78,79,78                                                3810
78    PRINT 26,(TEDIT(I),I=1,NTEDT)                                     3820
79    JB1=1                                                             3830
      PRINT 28                                                          3840
      DO 85 M=1,NMTRLS                                                  3850
      IF (JBND(M)) 81,80,81                                             3860
80    JB2=JFIN                                                          3870
      GO TO 82                                                          3880
81    JB2=JBND(M)                                                       3890
82    THKNS=X(JB2)-X(JB1)                                               3900
      PRINT 18,MATL(M),RHO(M),JB1,JB2                                   3910
      JB1=JB2                                                           3920
      PRINT 29,THKNS                                                    3930
      PRINT 19,EOSTC(M),EOSTD(M),EOSTL(M),EOSTG(M),EOSTH(M),EOSTS(M),EOS 3940
     1TN(M),PMIN(M)                                                     3950
      IF(CUSPA(M)) 84,84,83                                             3960
83    PRINT 20,CUSP1(M),CUSPA(M),CUSPC(M),CUSPD(M),CUSPG(M),CUSPS(M)    3970
84    NOED=NOE(M)                                                       3980
      PRINT 21,NOED                                                     3990
      PRINT 22,(AA(M,I),B(M,I),EDGE(M,I),I=1,NOED)                      4000
85    CONTINUE                                                          4010
C                                                                       4020
C                          START DEPOSITION EDIT                        4030
C                                                                       4040
      PRINT 23,(DISCPT(I),I=1,10)                                       4050
      M=1                                                               4060
      SUMCAL=0.                                                         4070
      DO 92 J=2,JFIN                                                    4080
      ERR=ER(J)*SDUR                                                    4090
```

```
      IF (J-(J_NC(M)+1)) 87,86,87                                       4100
86    M=M+1                                                             4110
87    IF (ERR*COST2(M)-1.E-7) 88,88,90                                  4120
88    IF (JSTAR) 89,89,90                                               4130
89    JSTART=J                                                          4140
90    DX=X(J)-X(J-1)                                                    4150
      ERRPA=ERR*RHO(M)*DX                                               4160
      CALPA=ERRPA*1.E-7/4.186                                           4170
      SUMCAL=SUMCAL+CALPA                                               4180
      PRINT 94,J,DX,X(J),ERRPA,CALPA,SUMCAL,PTS,U(J),ZM(J),J            4190
      IF(X(J).GE.(.6)) 92,91,92                                         4200
91    PRINT 93,(DISCRT(I),I=1,10)                                       4210
      CONTINUE                                                          4220
      IF (JSTAR ) 95,95,94                                              4230
94    JSTAR=JFIN                                                        4240
95    PRINT 96                                                          4250
      RETURN                                                            4260
      END                                                               4270
```

```
      SUBROUTINE FOR THE DUFF HYDRO CODE
      IMPLICIT REAL*8
      COMMON AA(6,20),AC(10,10,6),B(6,20),CUSPI(6),CUSPA(6),CUSPC(6),
     1CUSPD(6),CUSPG(6),CUSPR(6),DISCPT(12),EE(10),EDGE(6,20),EI(10,10),
     2EQSTA(6),EQSTD(6),EQSTE(6),EQSTG(6),EQSTH(6),EQSTN(6),EQSTS(6),
     3JUMP(6),JUDIT(10),JUSR(10),MATL(6),NJE(6),NZ(20),PMIN(6),RHO(6),
     4RZ(6,5),SIE(20),T(10),THL(10),TEDIT(25),X(801)
      COMMON CYC,DTN,DTNH,ETN,JCT,JCYC,JFIN,JPMAX,JPMAXI,JRZL,JSTAR,JXXC,JZ
     1PCL,LINE,LOZMIZ,NCYC,NJEDIT,NMTRLS,NPRIN,NRZ,NTAPE,NTEDT,PMAX,
     2R,TIME,TN,TTAPE,ZPCL
      DIMENSION P(1),U(1),CS(1),E(1),V(1),ZM(1),U(1)
      EQUIVALENCE (AC,P),(AC(802),Q),(AC(1603),CS),(AC(2404),E),(AC(3205
     1),V),(AC(4006),ZM),(AC(4807),U)
      FORMAT (F10.3,4I10)
                  REZONE AHEAD OF MAIN PRESSURE PULSE
      CRNCH=0.
      JTAPE=1.
      IF (JPMAX-JZPCL-JRZL-JPMAXI) 87,87,2
      JV=1
      M=1
      DO 6 J=1,JSTAR
      IF (J-JPND(M)) 4,3,4
      M=M+1
4     IF (RHO(M)*V(J+1)-1.2) 7,5,5
5     JV=J
6     CONTINUE
7     IF (ZPCL) 48,48,8
      J=JPMAX+3
      XJPMAX=X(JPMAX)
      SMVPL=0.
      SMVPL=SMVPL+U(JM)*.5*(ZM(JM+1)+ZM(JM))
      IF (U(JM-1)) 12,12,10
10    IF (JM-1) 12,12,11
11    JM=JM-1
      GO TO 9
12    JM=JPMAX+4
      SMVPP=0.
13    SMVPP=SMVPP+U(JM)/2.*(ZM(JM)+ZM(JM+1))
      IF (JM-JSTAR) 14,14,15
14    JM=JM+1
      GO TO 13
15    SMVPP=SMVPL+SMVPP
      XTPP=SMVPP/PMAX
      RZMX=2.*XTPP*CS(JPMAX)/ZPCL
      J=JPMAX
16    J=J+1
      IF (J+1-JFIN) 17,48,48
17    IF (X(J)-X(J-1)-RZMX) 16,18,18
```

```
18    IF (J-JPMAX+20) 16,48,48                                          4850
19    IF (J-JXXO) 48,48,20                                              4860
20    CALL EDIT                                                         4870
      SCRNCH=1.                                                         4880
      JFINO=JFIN                                                        4890
      JXXO=J                                                            4900
      DO 22 MCK=1,NMTRLS                                                4910
      IF (J-1-JBND(MCK)) 23,21,22                                       4920
21    JCK=MCK                                                           4930
22    CONTINUE                                                          4940
      MCK=NMTRLS                                                        4950
23    ME=MCK                                                            4960
24    IF (JCK) 25,25,26                                                 4970
25    RZR=(.5*(X(J-1)+X(J))-X(J-2))/(X(J)-X(J-2))                       4980
      EL=E(J-1)+RZR*(E(J)-E(J-1))                                       4990
      VL=V(J-1)+RZR*(V(J)-V(J-1))                                       5000
      SSL=SS(J-1)+RZR*(SS(J)-SS(J-1))                                   5010
      IF (J-JBND(ME)) 26,27,26                                          5020
26    RZR=(X(J+1)-.5*(X(J)+X(J-1)))/(X(J+1)-X(J-1))                     5030
      ER=E(J+1)+RZR*(E(J)-E(J+1))                                       5040
      VR=V(J+1)+RZR*(V(J)-V(J+1))                                       5050
      SSR=SS(J+1)+RZR*(SS(J)-SS(J+1))                                   5060
      IF (JCK) 29,29,28                                                 5070
27    RZR=(.5*(X(J)-X(J-1)))/(X(J)-X(J-2))                              5080
      ER=E(J)+RZR*(E(J)-E(J-1))                                         5090
      VR=V(J)+RZR*(V(J)-V(J-1))                                         5100
      SSR=SS(J)+RZR*(SS(J)-SS(J-1))                                     5110
      GO TO 29                                                          5120
28    RZR=(.5*(X(J)-X(J-1)))/(X(J+1)-X(J-1))                            5130
      EL=E(J)+RZR*(E(J)-E(J+1))                                         5140
      VL=V(J)+RZR*(V(J)-V(J+1))                                         5150
      SSL=SS(J)+RZR*(SS(J)-SS(J+1))                                     5160
29    XR=X(J)                                                           5170
      XL=.5*(X(J)+X(J-1))                                               5180
      ZMR=(XR-XL)/VR                                                    5190
      ZML=(XR-XL)/VL                                                    5200
      UR=U(J)                                                           5210
      UL=((ZM(J)-ZML)*U(J-1)+(ZM(J)-ZMR)*U(J))/(ZML+ZMR)                5220
      DEN=1./VL                                                         5230
      CALL EQST (EL,DEN,PL,ME)                                          5240
      DEN=1./VR                                                         5250
      CALL EQST (ER,DEN,PR,ME)                                          5260
      QL=Q(J)                                                           5270
      QR=Q(J)                                                           5280
      CSL=CS(J)                                                         5290
      CSR=CS(J)                                                         5300
      JDO=J                                                             5310
      JI=ME                                                             5320
      DO 31 NME=JDO,JFIN                                                5330
      IF (NME-JBND(JI)) 31,30,31                                        5340
30    JBND(JI)=NME+1                                                    5350
      JI=JI+1                                                           5360
31    CONTINUE                                                          5370
      JXX=J                                                             5380
      J=JFIN                                                            5390
32    X(J+1)=X(J)                                                       5400
      U(J+1)=U(J)                                                       5410
```

```
      ZM(J+1)=ZM(J)                                                    5420
      V(J+1)=V(J)                                                      5430
      E(J+1)=E(J)                                                      5440
      P(J+1)=P(J)                                                      5450
      Q(J+1)=Q(J)                                                      5460
      CS(J+1)=CS(J)                                                    5470
      SS(J+1)=SS(J)                                                    5480
      J=J-1                                                            5490
      IF (J-JXX) 33,33,32                                              5500
32    X(J+1)=XR                                                        5510
      X(J)=XL                                                          5520
      U(J+1)=UR                                                        5530
      U(J)=UL                                                          5540
      ZM(J+1)=ZMR                                                      5550
      ZM(J)=ZML                                                        5560
      V(J+1)=VR                                                        5570
      V(J)=VL                                                          5580
      E(J+1)=ER                                                        5590
      E(J)=EL                                                          5600
      P(J+1)=PR                                                        5610
      P(J)=PL                                                          5620
      Q(J+1)=QR                                                        5630
      Q(J)=QL                                                          5640
      CS(J+1)=CSR                                                      5650
      CS(J)=CSL                                                        5660
      SS(J+1)=SSR                                                      5670
      SS(J)=SSL                                                        5680
      IF(NJEDIT) 37,37,34                                              5690
34    DO 36 II=1,NJEDIT                                                5700
      IF(J-JEDIT(II)) 35,35,36                                         5710
35    JEDIT(II)=JEDIT(II)+1                                            5720
36    CONTINUE                                                         5730
37    IF(J-JSTAR) 38,38,39                                             5740
38    JSTAR=JSTAR+1                                                    5750
39    JFIN=JFIN+1                                                      5760
      IF (X(J)-X(J-1)-RZDX) 40,24,24                                   5770
4     IF (J-JXXO-20) 41,47,47                                          5780
41    J=J+2                                                            5790
      IF (J-JFIN) 42,47,47                                             5800
42    IF (E(J+1)) 43,43,44                                             5810
43    E(J+1)=VINIF(TIME-DTNH,SPUR)*SS(J+1)                             5820
44    IF (J-1-JBND(ME)) 45,46,45                                       5830
45    JOK=0                                                            5840
      GO TO 26                                                         5850
46    ME=ME+1                                                          5860
      JOK=1                                                            5870
      GO TO 26                                                         5880
47    JRZ=JFINO-JFIN                                                   5890
      PRINT 1,TIME,N,JRZ,JSTAR                                         5900
C                                                                      5910
C                 REZONE BEHIND MAIN PRESSURE PULSE                    5920
C                                                                      5930
48    IF (JRZL) 87,87,49                                               5940
49    IF (N-NRZ-100) 87,87,50                                          5950
50    JRZV=1                                                           5960
      NRZ=1                                                            5970
      JFINO=JFIN                                                       5980
```

```
      JFINS=JFIN+1                                                      5990
      M=MRZ                                                             6000
      KRZ=                                                              6010
      J=JPMAX                                                           6020
      J=J-1                                                             6030
      IF (P(J)/PMAX-.2) 52,52,51                                        6040
   51 JPLC=J                                                            6050
      IF (JPLC-JV-JRZL) 53,53,60                                        6060
   53 IF (JPMAX-JPLC-JZPUL) 54,54,55                                    6070
   54 IF (KRZ) 57,57,56                                                 6080
   55 J=JPLC+1                                                          6090
      DO 56 MM=1,NMTRLS                                                 6100
      IF (JPLC+1-JBND(MM)) 57,57,56                                     6110
   56 CONTINUE                                                          6120
      MM=NMTRLS                                                         6130
      M=MM                                                              6140
      DO 58 MM=1,NMTRLS                                                 6150
      IF (JPMAX-JBND(MM)) 59,59,58                                      6160
   58 CONTINUE                                                          6170
      MM=NMTRLS                                                         6180
   59 RZR=RZRX*.5*V(JPMAX)*RHO(MM)                                      6190
      KRZ=-1                                                            6200
      GO TO 63                                                          6210
   60 KRZ=1                                                             6220
      DO 61 MM=1,NMTRLS                                                 6230
      IF (JV+1-JBND(MM)) 62,62,61                                       6240
   61 CONTINUE                                                          6250
      MM=NMTRLS                                                         6260
   62 M=MM                                                              6270
      RZR=(X(JPLC)-X(JV))/FLOATF(JRZL)                                  6280
      J=JV+1                                                            6290
   63 IF (SCRNCH) 64,64,65                                              6300
   64 CALL EDIT                                                         6310
      SCRNCH=1.                                                         6320
   65 IF (X(J+1)-X(J)-RZR) 66,81,81                                     6330
   66 IF (J+1-JBND(M)) 67,81,67                                         6340
   67 IF(NJEDIT) 70,70,68                                               6350
   68 DO 69 II=1,NJEDIT                                                 6360
      IF (J+1-JEDIT(II)) 69,81,69                                       6370
   69 CONTINUE                                                          6380
   70 ZMINV=1./(ZM(J+1)+ZM(J+2))                                        6390
      U(J+1)=(U(J+1)*ZM(J+1)+U(J+2)*ZM(J+2))*ZMINV                      6400
      V(J+1)=(V(J+1)*ZM(J+1)+V(J+2)*ZM(J+2))*ZMINV                      6410
      E(J+1)=(E(J+1)*ZM(J+1)+E(J+2)*ZM(J+2))*ZMINV                      6420
      DEN=1./V(J+1)                                                     6430
      CALL EOST (E(J+1),DEN,P(J+1),M)                                   6440
      JA=(ZM(J)*U(J)+ZM(J+1)*(U(J)+U(J+1)))/(ZM(J)+2.*ZM(J+1))          6450
      ZMC=ZM(J+1)+2.*ZM(J+2)                                            6460
      IF (ZMC) 71,72,71                                                 6470
   71 C=(ZM(J+1)*U(J+2)+ZM(J+1)*(U(J+2)+U(J+1)))/ZMC                    6480
      GO TO 73                                                          6490
   72 C=0.                                                              6500
   73 ZM(J+1)=ZM(J+1)+ZM(J+2)                                           6510
      U(J+1)=(U(J+1)+U(J+2))/2.0                                        6520
      E(J+1)=(E(J+1)+E(J+2))/2.0                                        6530
      U(J)=JA                                                           6540
      U(J+1)=C                                                          6550
```

```
      X(J+1)=X(J+2)                                                     6560
      JX=J+2                                                            6570
      DO 74 JC=JX,JFIN                                                  6580
      X(JC)=X(JC+1)                                                     6590
      U(JC)=U(JC+1)                                                     6600
      ZM(JC)=ZM(JC+1)                                                   6610
      V(JC)=V(JC+1)                                                     6620
      E(JC)=E(JC+1)                                                     6630
      P(JC)=P(JC+1)                                                     6640
      Q(JC)=Q(JC+1)                                                     6650
      CS(JC)=CS(JC+1)                                                   6660
      SS(JC)=SS(JC+1)                                                   6670
74    CONTINUE                                                          6680
      JFIN=JFIN-1                                                       6690
      IF(NJEDIT) 78,78,75                                               6700
75    DO 77 II=1,NJEDIT                                                 6710
      IF (J-JEDIT(II)) 76,77,77                                         6720
76    JEDIT(II)=JEDIT(II)-1                                             6730
77    CONTINUE                                                          6740
78    JPMAX=JPMAX-1                                                     6750
      JSTAR=JSTAR-1                                                     6760
      JPLC=JPLC-1                                                       6770
      JXXO=JXXO-1                                                       6780
      DO 80 M1=1,NMTRLS                                                 6790
      IF (JBND(M1)-J-2) 80,79,79                                        6800
79    JBND(M1)=JBND(M1)-1                                               6810
80    CONTINUE                                                          6820
C     END COLLAPSE                                                      6830
81    IF (KR7) 83,87,82                                                 6840
82    IF (J-JPLC) 84,53,53                                              6850
83    IF (J+4-JPMAX) 84,86,86                                           6860
84    J=J+1                                                             6870
      IF (J-JBND(M)) 65,85,85                                           6880
85    M=M+1                                                             6890
      GO TO 65                                                          6900
86    JRZ=JFIND-JFIN                                                    6910
      JPMAX1=JPMAX1-JRZ                                                 6920
      NRZ=N                                                             6930
      PRINT 1,TIME,N,JRZ,JSTAR                                          6940
      CONTINUE                                                          6950
87    IF (SCRNCH) 89,89,88                                              6960
88    CALL EDIT                                                         6970
89    RETURN                                                            6980
      END                                                               6990
```

```
      SUBROUTINE EDIT
C
      COMMON AA(6,20),AC(10,10,6),B(6,20),CUSP1(6),CUSPA(6),CUSPC(6),
     1CUSPT(6),CUSPG(6),CUSPN(6),ISCPT(12),EE(10),EDGE(6,20),EI(10,10),
     2GST(6),EGSTG(6),EGSTE(6),EGSTS(6),EGSTH(6),EGSTN(6),EGSTS(6),
     3JW(6),JEDIT(10),JORG(10),MATL(6),NOE(6),NZ(20),PMIN(6),RHO(6),
     4W2(20),X(801),Y(10),TBL(100),TEDIT(25),X(801)
C
      COMMON DTN,DTNH,DTN,JCK,JCYCS,JFIN,JPMAX,JPMAXI,JRZL,JSTAR,JXXC,JY
     1FLG,LINE,LOZHIZ,N,NBR,NJEDIT,NMTRLS,NPRIN,NRZ,NTAPE,NTEDT,PMAX,
     2R,TIME,TC,WTAPE,ZPUL
C
      COMMON/COM/ R(1),V(1),CS(1),E(1),V(1),ZM(1),U(1)
C
      EQUIVALENCE (AC,R),(AC(802),C),(AC(1603),CS),(AC(2404),E),(AC(3205
     1),V),(AC(4006),ZM),(AC(4807),U)
C
      FORMAT(1H06X,5HCYCLE8X,4HTIME8X,4HDTNH7X,5HJSTAR7X,5HJPMAX8X,4HPMIN
     1X,6HXJPMAX5X,7HMVPULSE6X,6HMVPREC4X,8HMOMENTUM/8X,4HETPP6X,6HETP
     2LL6X,6HETOTAL6X,6HENVNEG6X,6HENVPOS5X,7HL-BOUND4X,8HX(JBND1)4X,
     3/4HX(J,JJ)5X,7HG- CONS8X,4HJFIN/2X,I10,2E12.4,2E12.4,9E12.4,
     4I10)
      FORMAT(1H1)
                          BINARY DATA STORAGE
      XJPMAX=X(JPMAX)
      IF (WTAPE) 3,7,3
    3 JSTARD=JSTAR+1
      WRITE TAPE 6,N,TIME,(R(J),J=1,10),JSTAR,JFIN,JPMAX,JSTARD
      IF(EOF,6) 5,4
    4 WRITE TAPE 6,(J,X(J),U(J),R(J),S(J),E(J),V(J),CS(J),J=1,JSTARD)
      IF(EOF,6) 5,7
    5 PRINT 6,N
    6 FORMAT (16H NEW 06 AT CYCLE,I10)
      END FILE 6
      REWIND 6
      PAUSE 61
      GO TO 7
C
C                  MOMENTUM AND ENERGY CALCULATION
C
    7 MVNEG=0.
      MVPOS=0.
      JFIN=0.
      MV=0.
      JSTAR1=JSTAR+1
      DO 11 J=1,JSTAR1
      V=(V(J)*ZM(J)+V(J-1)*ZM(J-1))/2.
      IF(V)10,9,9
    9 MVNEG=MVNEG+V
      GO TO 11
   10 MVPOS=MVPOS+V
   11 CONTINUE
      JMV=(MVPOS+MVNEG)*ZM(J)/4.186E7
      ETOTAL=(MVPOS+ZM(J)*(U(J)+U(J-1))**2/4.186E7/2.
   12 CONTINUE
      ETOTAL=ETOTAL+EMIN
```

```
      JM=JMAX+3                                                          7750
      EMVPL=0.                                                           7760
   11 EMVPL=EMVPL+U(JM)*.5*(ZM(JM+1)+ZM(JM))                             7770
      IF(JM-JBMAX) 13,14,14                                              7780
   13 IF(U(JM-1)) 16,16,14                                               7790
   14 IF (JM-1) 16,16,15                                                 7800
   15 JM=JM-1                                                            7810
      GO TO 12                                                           7820
   16 JM=JBMAX+4                                                         7830
      EMVPR=0.                                                           7840
   17 EMVPR=EMVPR+U(JM)/2.*(ZM(JM)+ZM(JM+1))                             7850
      IF(JM-JSTAR) 18,19,19                                              7860
   18 JM=JM+1                                                            7870
      GO TO 17                                                           7880
   19 EMVPL=EMVPL+EMVPR                                                  7890
      DTPP=EMVPR/PMAX                                                    7900
      DTPOL =EMVPL/PMAX                                                  7910
                        PRINT OUTPUT VARIABLES                           7920
      JBND1=JBND(1)                                                      7930
      JBND2=JBND(2)                                                      7940
      PRINT 1,N,TIME,DTNH,JSTAR,JBMAX,PMAX,XJBMAX,EMVPL,EMVPR,EMVPP,DTPP 7950
     1,DTPOL,PTOTAL,EMVNEG,EMVPOS,X(1),X(JBND1),X(JBND2),X(JFIN),JFIN    7960
      LINE=LINE+3                                                        7970
      IF(SENSE(LINE,50)) 21,20,21                                        7980
   20 PRINT 2                                                            7990
   21 RETURN                                                             8000
      END                                                                8010
```

```
      EVALUATION OF STATE VARIABLES FOR THE TWO-DIMENSIONAL CODE
      SUBROUTINE STATE(I,*,*)
C
      COMMON AA(6,20),A(10,100,6),H(6,10),C(6),PI(6),CUPA(6),CUPC(6),
     1CUPB(6),CUPD(6),CUPR(6),DISCRT(12),IE(10),EDGE(6,20),EI(10,10)
     2,FQSTC(6),EQSTC(6),EQSTS(6),EQST3(6),EQSTH(6),EQSTN(6),EQSTS(6),
     3UNC(6),JEPSIT(10),JORG(10),PATL(6),NCF(6),NZ(20),PMIN(6),RHO(6),
     4Z(20),C(401),T(10),TLIT(10),TLIT(25),X(501)
C
      COMMON/CONST/ETAM,ETAN,JC,JCX,JCXM,JFIN,JPMAX,JPMAX1,JR2L,JSTAR,JYXO,JZ
     1PCL,LIMP,LO2MI2,MAN,MEQUIT,NMTRL,NSHIN,NN2,NTAPE,NTELOT,PMAX,
     2MUR,TIME,TMAX,TAPE,ZPEL
C
      DIMENSION S(1),L(1),C(1),(1),V(1),ZM(1),(1)
C
      EQUIVALENCE (P,S),(AC(802),C),(AC(1602),C),(AC(2404),L),(AC(3
     1),(4 ),),(AC(4807),J)
C
C
      ENUM=D/RHO(M)
      EMUP=ENUM-1.
      VI=PMO(M)/
      IF (M ) 1,5,5
C
C                              VAPOR EQUATION
C
      ENUM=E (M)*(1.-VI)*VI
      IF (EN 2+1 .) 3,3,4
      TP1=EQST (M)*(1.-EXPF( 2))
      GO TO 
      TP1= QST(M)
      TP= /(EQ TH(M)+(EQSTS(M)- QSTH( ))/ RTF(ENU))
      RI=(AX(F(M),( ),( -TP1)*T /RHO( ))
      GO TO 
C
C                          TWO-WAVE SOLID EQUATION
C
      IF( 2)) 6, .6
      =P/RHO(M)
      IF( ) 7,8,7
      = (( EQST(M)*AVG+C (M))*AR +CUPB(M))*ARG
      P1=( (M)+TST+LI+CUP (M)*
      GO TO
C
C                          ONE-WAVE SPLIT EQUATION
C
      = (( QST (M)*PU+E (M))/ 2+( STE( ))*E-U
      =T +( TC(M)*C
      TP
      
```

APPENDIX II

FORTRAN LISTING OF P PUFF

```
      PROGRAM P PUFF                                                    10
C     THIS IS PUFF FOR PLATE SLAPS ONLY FOR THE AWFL 1604 *****         20
      COMMON CS(500),CUSP1(6),CUSPA(6),CUSPC(6),CUSPD(6),CUSPG(6),      30
     1CUSPS(6),DISCPT(12),E(500),EQSTC(6),EQSTD(6),EQSTE(6),EQSTG(      40
     26),EQSTH(6),EQSTN(6),EQSTS(6),JBND(6),JEDIT(10),JORG(10),MATL(6),M 50
     3Z(20),P(500),PMIN(6),Q(500),RHO(6),RZ(20),TEDIT(25),U(500),V(500), 60
     4X(500),ZM(500)                                                    70
C                                                                       80
      COMMON CKP,DTN,DTNH,JCK,JCYCS,JFIN,JFIN2,JPMAX,JRZL,JSTAR,JXXC,JZZ 90
     1UL,LINE,N,NJEDIT,NMTRLS,NPRIN,NRZ,NTAPE,NTEDT,PMAX,TIME,TS,UZERO, 100
     2WTAPE,ZPUL                                                        110
C                                                                       120
C     ZEROES COMMON                                                     130
C                                                                       140
      DO 1 K=1,4225                                                     150
1     CS(K)=0.                                                          160
      CALL GENRAT                                                       170
C                                                                       180
C              INITIALIZE  COUNTERS AND CONSTANTS                       190
C                                                                       200
      LINE=0                                                            210
      FLAG=0.                                                           220
      C0=1.6                                                            230
      C1=.25                                                            240
      TWOC1=2.*C1                                                       250
      COSQ=C0*C0                                                        260
      FORCSQ=4.*COSQ                                                    270
      II=1                                                              280
      N=1                                                               290
      DTN=TIME                                                          300
      DTNH=TIME                                                         310
      JSTAR=JBND(1)+3                                                   320
C                                                                       330
C     HYDRO STARTS HERE                                                 340
C                        TIME LOOP                                      350
C                                                                       360
2     SK2M=0.                                                           370
      PMAX=0.                                                           380
      M=1                                                               390
      LL=1                                                              400
C     DETERMINE THE LEFT BOUNDARY CONDITIONS                            410
      U(1)=U(1)-DTN*(Q(2)+P(2))/ZM(2)                                   420
      X(1)=X(1)+DTNH*U(1)                                               430
C                                                                       440
C              MAIN LOOP FOR HYDRO CALCULATION                          450
C                                                                       460
      JFINM1=JFIN-1                                                     470
      DO 22 J=1,JFINM1                                                  480
      QOLD=Q(J+1)                                                       490
      POLD=P(J+1)                                                       500
```

```
      VOLD=V(J+1)                                                          510
      IF (J+1-JBND(M)) 4,3,4                                               520
    3 LL=LL+1                                                              530
    4 U(J+1)=U(J+1)-DTN*(P(J+2)+Q(J+2)-P(J+1)-Q(J+1))/(ZM(J+1)+ZM(J+2))    540
      IF(ABSF(U(J+1))-1.E-3) 5,5,6                                         550
    5 U(J+1)=0.0                                                           560
    6 X(J+1)=X(J+1)+DTNH*U(J+1)                                            570
      DU=U(J+1)-U(J)                                                       580
      V(J+1)=(X(J+1)-X(J))/ZM(J+1)                                         590
      VAVG=(V(J+1)+VOLD)/2.0                                               600
      DV=DTNH*DU/ZM(J+1)                                                   610
      IF (DU+1.) 7,8,8                                                     620
    7 Q(J+1)=(DU*COSQ-C1*CS(J+1))*DU/VAVG                                  630
      IF (Q(J+1)-1.) 8,9,9                                                 640
    8 Q(J+1)=0.0                                                           650
      DU=0.0                                                               660
      CS(J+1)=0.0                                                          670
    9 DNEW=1./V(J+1)                                                       680
      EOLD=E(J+1)                                                          690
      CALL EQST (E(J+1),DNEW,P2,M)                                         700
      E1=E(J+1)-P(J+1)*DV                                                  710
      CALL EQST (E1,DNEW,P1,M)                                             720
      E(J+1)=E(J+1)-(P2+P(J+1)+Q(J+1)+QOLD)*DV/(2.-(P1-P2)/P(J+1))         730
      P(J+1)=P2+(P2-P1)*(E(J+1)-EOLD)/POLD/DV                              740
      DLTD=.001*DNEW                                                       750
      IF (DV) 11,11,10                                                     760
   10 DFUDG=DNEW+DLTD                                                      770
      GO TO 12                                                             780
   11 DFUDG=DNEW-DLTD                                                      790
   12 CALL EQST (E(J+1),DFUDG,PFUDG,M)                                     800
      DPDRHO=(PFUDG-P(J+1))/(DFUDG-DNEW)                                   810
      IF (DPDRHO) 13,13,14                                                 820
   13 SPEED=0.                                                             830
      GO TO 15                                                             840
   14 SPEED=SQRTF(DPDRHO)                                                  850
   15 SK2M1=(SPEED+TWOC1*CS(J+1)-FORCSQ*DU)/(X(J+1)-X(J))                  860
      CS(J+1)=SPEED                                                        870
C                                                                          880
      IF (P(J+1)-PMAX) 17,16,16                                            890
   16 PMAX=P(J+1)                                                          900
      JPMAX=J+1                                                            910
   17 IF (SK2M-SK2M1) 18,18,19                                             920
   18 SK2M=SK2M1                                                           930
   19 M=LL                                                                 940
      IF (U(J+1)) 22,20,22                                                 950
   20 IF(J-JSTAR) 22,21,21                                                 960
   21 JSTAR=J                                                              970
      GO TO 23                                                             980
   22 CONTINUE                                                             990
C                              MAIN LOOP ENDS HERE                        1000
      JSTAR=JFINM1                                                        1010
C                                                                         1020
C                                                                         1030
C     EXIT AND EDIT CONTROL                                               1040
C                                                                         1050
   23 IF (TIME-TS) 24,26,26                                               1060
   24 IF (N-JCYCS) 25,26,26                                               1070
```

```
      IF (X(JPMAX)-CKP) 30,26,26
26    FLAG=1.
27    WTAPE=1.
      CALL EDIT
      END FILE 4
      END FILE 6
      REWIND 4
      REWIND 6
      IF(FLAG) 28,29,28
28    REWIND 45
      STOP
29    CALL DDTF
      PAUSE
30    IF (SENSE SWITCH 2) 31,33
31    PRINT 32,N
32    FORMAT (31H SENSE SWITCH 2 IS ON AT CYCLE I10)
      GO TO 27
33    IF (XMODF(N,NTAPE)) 35,34,35
34    WTAPE=1.
      CALL EDIT
      GO TO 37
35    IF (XMODF(N,NPRIN)) 37,36,37
36    WTAPE=0.
      CALL EDIT
C                              CYCLE ADVANCE
C
37    SK2M=MINIF(.8/SK2M,1.2*DTNH)
      IF(NJEDIT) 38,40,38
38    WRITE TAPE 4,NJEDIT,N,TIME
      DO 39 I=1,NJEDIT
      JB=JEDIT(I)
39    WRITE TAPE 4,JORG(I),JEDIT(I),P(JB+1)
40    DTN=DTNH
      DTNH=SK2M
      CALL REZONE
      IF (TEDIT(II)) 45,45,41
41    IF (NTEDT) 42,44,42
42    IF (TIME+DTNH-TEDIT(II)) 45,45,43
43    DTNH=TEDIT(II)-TIME
      NTEDT=0
      GO TO 45
44    WTAPE=1.
      CALL EDIT
      II=II+1
      NTEDT=1
45    TIME=TIME+DTNH
      DTN=DTN+DTNH
      N=N+1
      IF (DTNH) 46,46,2
46    PAUSE2
      GO TO 2
      END
```

```
      GENERATOR  SUBROUTINE FOR THE PUFF HYDRO CODE
      SUBROUTINE GENRAT
      COMMON CS(500),CUSP1(6),CUSPA(6),CUSPC(6),CUSPD(6),CUSPG(6),
     1CUSPS(6),DISCPT(12),E(500),EQSTC(6),EQSTD(6),EQSTE(6),EQSTG(
     26),EQSTH(6),EQSTN(6),EQSTS(6),JBND(6),JEDIT(10),JCRS(10),MAT(6),M
     3Z(20),P(500),PMIN(6),Q(500),RHO(6),RZ(20),TEDIT(25),U(500),V(500),
     4X(500),ZM(500)
      COMMON CKP,DTN,DTNH,JCK,JCYCS,JFIN,JFIN2,JRMAX,JRZL,JSTAR,JXX(,JZP
     1UL,LINE,N,NJEDIT,NMTRLS,NPRIN,NRZ,NTAPE,NTEDT,PMAX,TIME,TW,UZERO,
     2WTAPE,ZPUL
C
    1 FORMAT(10A8)
    2 FORMAT (8I10)
    3 FORMAT (8E10.3)
    4 FORMAT (45H ERROR--INPUT CARDS ARE NOT PROPERLY PREPARED)
    5 FORMAT (25H1INPUT PARAMETERS FOR - -/1H0(8A8)
    6 FORMAT(46H **** THIS PROBLEM WAS RUN ON P-PUFF/1604 ****)
    7 FORMAT(1H0,5X,4HNRZC,4X,6HNMTRLS,6X,4HJRZL,5X,5HJZPUL,5X,5HNPRIN,5X,
     15HUFACE,5X,5HUZERO,5X,5HJFIN2/5I10,2E10.3,I10)
    8 FORMAT (//17H ZONING CONSTANTS//)
    9 FORMAT (3X,6H RATIO,E10.3,8H TO ZONE,I6)
   10 FORMAT (1H0,5X,4HJFIN,5X,5HJCYCS,5X,5HNTEST,5X,5HNTAPE,7X,3HCKP,8X,2HTW,6
     1X,4HTIME/4I10,3E10.3)
   11 FORMAT (25H0MATERIAL PROPERTIES FOR A6,5X,4HRHO=E10.3,5X,7HERG/ J=
     1I5,2X,5HTO J=I5)
   12 FORMAT (1H0,9X,5HEQSTC,10X,5HEQSTD,10X,5HEQSTE,10X,5HEQSTG,10X,5HEQSTH,
     10X,5HEQSTS,10X,5HEQSTN,11X,4HPMIN/3E15.5)
   13 FORMAT(1H0,9X,5HCUSP1,10X,5HCUSPA,10X,5HCUSPC,10X,5HCUSPD,10X,5HCUSPG,
     110X,5HCUSPS/6E15.5)
   14 FORMAT (1H1,10A8/5H0  J 6X,1HX,8X,8HVELOCITY,5X,9HZONE MASS//)
   15 FORMAT (1H  I3,3E14.5)
   16 FORMAT (1H1)
   17 FORMAT (1H0,10X,14HTHE TEDITS ARE/10E10.3/)
   18 FORMAT (1H0,10X,14HTHE JEDITS ARE/10I10)
   19 FORMAT (21H MATERIAL THICKNESS =E10.3)
C
C                              READ DATA
C
      READ 1,(DISCPT(I),I=1,10)
      READ 2,NRZC,NMTRLS,JRZL,JZPUL,NPRIN,NTAPE,NJEDIT,NTEDT
      IF(NTEDT) 21,21,20
   20 READ 3,(TEDIT(I),I=1,NTEDT)
   21 IF(NJEDIT) 23,23,22
   22 READ 2,(JEDIT(I),I=1,NJEDIT)
   23 ZPUL=JZPUL
      NMT=NMTRLS-1
      READ 3,UFACE,UZERO,UFIN2
      JFIN2=UFIN2
      IF (NMT) 25,25,24
   24 READ 2,(JBND(M),M=1,NMT)
   25 READ 2,JFIN,(NZ(L),L=1,NRZC)
      READ 3,DX,TIME,(RZ(M),M=1,NRZC)
      DX=DX/RZ(1)
      DO 26 M=1,NMTRLS
```

```
      READ 1,MATL(M)
      READ 3,RHO(M),EQSTC(M),EQSTD(M),EQSTE(M),EQSTG(M),EQSTH(M),(
     1),PMIN(M)
      READ 3,CUSP1(M),CUSPA(M),CUSPC(M),CUSPD(M),CUSPG(M),CUSPS(M)
26    EQSTN(M)=EQSTC(M)/EQSTG(M)/(EQSTE(M)*RHO(M))
      READ 3,CKP,TC
      READ 2,JCYCS,NTEST
      IF (NTEST-30) 27,28,27
27    PRINT 4
      STOP
28    CONTINUE
      IF(NJEDIT) 31,31,29
29    DO 30 I=1,NJEDIT
30    JORG(I)=JEDIT(I)
31    JCK=0
      JXXO=0
      NRZ=-50
C
C                              SET PLATE VELOCITY
C
      DO 32 J=1,JFIN2
      U(J)=UZERO
32    CONTINUE
      U(JFIN2)=UZERO*(1.+UFACE)/2.
      U(JFIN2+1)=UZERO*UFACE
      U(JFIN2+2)=U(JFIN2+1)/2.0
C
C                     COMPUTE DX USING ZONEING CONSTANTS
C
      LZ=1
      DO 35 J=1,JFIN
      IF (J-1-NZ(LZ)) 34,33,34
33    LZ=LZ+1
34    DX=DX*SZ(LZ)
35    X(J+1)=X(J)+DX
C
C                              SET UP ZONING FOR HYDRO
C
      M=1
      DO 37 J=2,JFIN
      V(J)=1./RHO(M)
      DM(J)=(X(J)-X(J-1))/V(J)
      IF (J-JBND(M)) 37,36,37
36    M=M+1
37    CONTINUE
C
C                              START INPUT EDIT
C
      PRINT 5
      PRINT 1,(DISCRT(K),K=1,10)
      PRINT 6
      PRINT 7,NRZC,NMTRLS,JRZL,JZRUL,NRPIN,UFACE,UZERO,JFIN2
      PRINT 8
      PRINT 9,(RZ(I),NZ(I),I=1,NRZC)
      PRINT 10,JFIN,JCYCS,NTEST,NTAPE,CKP,TC,TIME
      IF(NJEDIT) 41,39,39
      PRINT 13,(JEDIT(I),I=1,NJEDIT)
```

```
      IF (IOPT(11)) 41,41,4
42    PRINT 17,(TCDIT(I),I=1,NTCDIT)
41    JB1=1
      PRINT 16
      DO 47 M=1,NMTRLS
      IF (JBND(M)) 43,42,43
42    JB2=JFIN
      GO TO 44
43    JB2=JBND(M)
44    THKNS=X(JB2)-X(JB1)
      PRINT 11,MATL(M),RHO(M),JB1,JB2
      PRINT 19,THKNS
      PRINT 13,EQSTC(M),EQSTN(M),EQSTH(M),EQSTB(M),EQSTH(M),EQSTS(M),EQS
     1TN(M),PMIN(M)
      IF(CUSPA(M)) 46,46,45
45    PRINT 13,CUSPI(M),CUSPA(M),CUSPS(M),CUSPT(M),CUSPG(M),CUSPS(M)
46    JB1=JB2
47    CONTINUE

                          START VELOCITY EDIT


      PRINT 14,(DISCRT(I),I=1,10)
      JSDX=JFIN2+3
      DO 49 J=1,JSDX
      PRINT 15,J,X(J),U(J),ZM(J)
      IF (XMODF(J,50)) 49,48,49
48    PRINT 14,(DISCRT(I),I=1,10)
49    CONTINUE
      PRINT 16
      RETURN
      END
```

```
      SUBROUTINE REZONE
      COMMON (C(500),CUSP1(6),CUSP2(6),CUSP3(6),CUSP4(6),CUSP5(6),
     1CUSP6(6),DISCPT(12),E(500),EQSTC(6),EQSTE(6),EQSTE(6),EQSTG(
     26),EQSTH(6),EQSTN(6),EQSTS(6),JPNT(6),JPNIT(10),JORS(10),MATL(6),N
     3Z(  ),P(500),PMIN(6),Q(500),RHO(6),RZ(20),TEDIT(25),U(500),V(500),
     4X(  ),ZM(500)
      COMMON CKP,CTN,DTNH,JCK,JCYC,JFIN,JFIN2,JPMAX,JRZL,JSTAR,JXXO,JZP
     1UL,LINE,N,NJEDIT,NMTRLS,NPRINT,NRZ,NTAPE,NTEDT,PMAX,TIME,TP,UZERO,
     2ZTAPE,ZPUL

    1 FORMAT (F10.3,2I10)

C
C             REZONE AHEAD OF MAIN PRESSURE PULSE
C
      SCRNCH=0.
      WTAPE=1.
      IF (JPMAX-JZPUL-JRZL-10) 85,85,2
    2 JV=1
      M=1
      DO 6 J=1,JSTAR
      IF (J-JRND(M)) 4,3,4
    3 M=M+1
    4 IF (RHO(M)*V(J+1)-1.2) 7,5,5
    5 JV=J
      CONTINUE
      IF (ZPUL) 46,46,7
    7 JM=JPMAX+3
      XJPMAX=X(JPMAX)
      EMVPL=0.
    8 EMVPL=EMVPL+U(JM)*.5*(ZM(JM+1)+ZM(JM))
      IF (U(JM-1)) 12,12,10
   10 IF (JM-1) 12,12,11
   11 JM=JM-1
      GO TO 8
   12 JM=JPMAX+4
      EMVPR=0.
   13 EMVPR=EMVPR+U(JM)/2.*(ZM(JM)+ZM(JM+1))
      IF (JM-JSTAR) 14,14,15
   14 JM=JM+1
      GO TO 13
   15 EMVPR=EMVPL+EMVPR
      DTPR=EMVPR/PMAX
      DTMX=2.*DTPR*C(JPMAX)/ZPUL
      J=JPMAX
   16 J=J+1
      IF (J+1-JFIN) 17,46,46
   17 IF (X(J)-X(J-1)-RZDX) 18,18,19
   18 IF (J-JPMAX-20) 16,46,46
   19 IF (J-JXXO) 46,46,20
   20 CALL EDIT
      SCRNCH=1.
      JFINO=JFIN
      JXXO=J
      DO 22 MCK=1,NMTRLS
```

```
      IF (J-1-J[illegible](MC)) 21,21,22                                    [illegible]
21    J=MC                                                                  [illegible]
22    CONTINUE                                                              [illegible]
      MC=NMTRLS
      ME=MC                                                                 3660
24    IF (JCK) 25,25,26                                                     3670
25    RZR=(.5*(X(J-1)+X(J))-X(J-2))/(X(J)-X(J-2))                           3680
      EL=E(J-1)+RZR*(E(J)-E(J-1))                                           3690
      VL=V(J-1)+RZR*(V(J)-V(J-1))                                           3700
      IF (J-JBND(ME)) 26,27,26                                              3710
26    RZR=(X(J+1)-.5*(X(J)+X(J-1)))/(X(J+1)-X(J-1))                         3720
      ER=E(J+1)+RZR*(E(J)-E(J+1))                                           3730
      VR=V(J+1)+RZR*(V(J)-V(J+1))                                           3740
      IF (JCK) 29,29,28                                                     3750
27    RZR=(.5*(X(J)-X(J-1)))/(X(J)-X(J-2))                                  3760
      ER=E(J)+RZR*(E(J)-E(J-1))                                             3770
      VR=V(J)+RZR*(V(J)-V(J-1))                                             3780
      GO TO 29                                                              3790
28    RZR=(.5*(X(J)-X(J-1)))/(X(J+1)-X(J-1))                                3800
      EL=E(J)+RZR*(E(J)-E(J+1))                                             3810
      VL=V(J)+RZR*(V(J)-V(J+1))                                             3820
29    XR=X(J)                                                               3830
      XL=.5*(X(J)+X(J-1))                                                   3840
      ZMR=(XR-XL)/VR                                                        3850
      ZML=(XR-XL)/VL                                                        3860
      UR=U(J)                                                               3870
      UL=((ZM(J)-ZML)*U(J-1)+(ZM(J)-ZMR)*U(J))/(ZML+ZMR)                    3880
      DEN=1./VL                                                             3890
      CALL EOST (EL,DEN,PL,ME)                                              3900
      DEN=1./VR                                                             3910
      CALL EOST (ER,DEN,PR,ME)                                              3920
      QL=Q(J)                                                               3930
      QR=Q(J)                                                               3940
      CSL=CS(J)                                                             3950
      CSR=CS(J)                                                             3960
      JDO=J                                                                 3970
      JI=ME                                                                 3980
      DO 31 NME=JDO,JFIN                                                    3990
      IF (NME-JBND(JI)) 31,30,31                                            4000
30    JBND(JI)=NME+1                                                        4010
      JI=JI+1                                                               4020
31    CONTINUE                                                              4030
      JXX=J                                                                 4040
      J=JFIN                                                                4050
32    X(J+1)=X(J)                                                           4060
      U(J+1)=U(J)                                                           4070
      ZM(J+1)=ZM(J)                                                         4080
      V(J+1)=V(J)                                                           4090
      E(J+1)=E(J)                                                           4100
      P(J+1)=P(J)                                                           4110
      Q(J+1)=Q(J)                                                           4120
      CS(J+1)=CS(J)                                                         4130
      J=J-1                                                                 4140
      IF (J-JXX) 33,33,32                                                   4150
33    X(J+1)=XR                                                             4160
      X(J)=XL                                                               4170
      U(J+1)=UR                                                             4180
```

```
      U(J)=UL
      ZM(J+1)=ZMR
      ZM(J)=ZML
      V(J+1)=VR
      V(J)=VL
      E(J+1)=ER
      E(J)=EL
      P(J+1)=PR
      P(J)=PL
      Q(J+1)=QR
      Q(J)=QL
      CS(J+1)=CSR
      CS(J)=CSL
      IF(NJEDIT) 37,37,34
34    DO 36 II=1,NJEDIT
      IF(J-JEDIT(II)) 35,35,36
35    JEDIT(II)=JEDIT(II)+1
36    CONTINUE
37    IF(J-JSTAR) 38,38,39
38    JSTAR=JSTAR+1
39    JFIN=JFIN+1
      IF (X(J)-X(J-1)-RZDX) 40,24,24
40    IF (J-JXXO-20) 41,45,45
41    J=J+2
      IF (J-JFIN) 42,45,45
42    IF (J-1-JBND(MF)) 43,44,43
43    JCK=0
      GO TO 26
44    MF=MF+1
      JCK=1
      GO TO 26
45    JRZ=JFINO-JFIN
      PRINT 1,TIME,N,JRZ,JSTAR
C
C                REZONE BEHIND MAIN PRESSURE PULSE
C
46    IF (JRZL) 85,85,47
47    IF (N-NRZ-100) 85,85,48
48    JRZV=1
      MRZ=1
      JFINO=JFIN
      JFINS=JFIN+1
      M=MRZ
      KRZ=0
      J=JPMAX
49    J=J-1
      IF (P(J)/PMAX-.2) 50,50,49
50    JPLC=J
      IF (JPLC-JV-JRZL) 51,51,58
51    IF (JPMAX-JPLC-JZPUL) 52,52,53
52    IF (KRZ) 85,85,84
53    J=JPLC+1
      DO 54 MM=1,NMTRLS
      IF (JPLC+1-JBND(MM)) 55,55,54
54    CONTINUE
      MM=NMTRLS
55    M=MM
```

```
      DO 56 MM=1,NMTRLS                                                 4760
      IF (JPMAX-JBND(MM)) 57,57,56                                      4770
56    CONTINUE                                                          4780
      MM=NMTRLS                                                         4790
57    RZR=RZDX*.5*V(JPMAX)*RHO(MM)                                      4800
      KRZ=-1                                                            4810
      GO TO 61                                                          4820
58    KRZ=1                                                             4830
      DO 59 MM=1,NMTRLS                                                 4840
      IF (JV+1-JBND(MM)) 60,60,59                                       4850
59    CONTINUE                                                          4860
      MM=NMTRLS                                                         4870
60    M=MM                                                              4880
      RZR=(X(JPLC)-X(JV))/FLOATF(JRZL)                                  4890
      J=JV+1                                                            4900
61    IF (SCRNCH) 62,62,63                                              4910
62    CALL EDIT                                                         4920
      SCRNCH=1.                                                         4930
63    IF (X(J+1)-X(J)-RZR) 64,79,79                                     4940
64    IF (J+1-JBND(M)) 65,79,65                                         4950
65    IF(NJEDIT) 68,68,66                                               4960
66    DO 67 II=1,NJEDIT                                                 4970
      IF (J+1-JEDIT(II)) 67,79,67                                       4980
67    CONTINUE                                                          4990
68    ZMINV=1./(ZM(J+1)+ZM(J+2))                                        5000
      V(J+1)=(V(J+1)*ZM(J+1)+V(J+2)*ZM(J+2))*ZMINV                      5010
      E(J+1)=(E(J+1)*ZM(J+1)+E(J+2)*ZM(J+2))*ZMINV                      5020
      DEN=1./V(J+1)                                                     5030
      CALL EGST (E(J+1),DEN,P(J+1),M)                                   5040
      UA=(ZM(J)*U(J)+ZM(J+1)*(U(J)+U(J+1)))/(ZM(J)+2.*ZM(J+1))          5050
      ZMC=ZM(J+3)+2.*ZM(J+2)                                            5060
      IF (ZMC) 69,70,69                                                 5070
69    UB=(ZM(J+3)*U(J+2)+ZM(J+2)*(U(J+2)+U(J+1)))/ZMC                   5080
      GO TO 71                                                          5090
70    UB=0.                                                             5100
71    ZM(J+1)=ZM(J+1)+ZM(J+2)                                           5110
      Q(J+1)=(Q(J+1)+Q(J+2))/2.0                                        5120
      CS(J+1)=(CS(J+1)+CS(J+2))/2.0                                     5130
      U(J)=UA                                                           5140
      U(J+1)=UB                                                         5150
      X(J+1)=X(J+2)                                                     5160
      JX=J+2                                                            5170
      DO 72 JC=JX,JFINS                                                 5180
      X(JC)=X(JC+1)                                                     5190
      U(JC)=U(JC+1)                                                     5200
      ZM(JC)=ZM(JC+1)                                                   5210
      V(JC)=V(JC+1)                                                     5220
      E(JC)=E(JC+1)                                                     5230
      P(JC)=P(JC+1)                                                     5240
      Q(JC)=Q(JC+1)                                                     5250
      CS(JC)=CS(JC+1)                                                   5260
72    CONTINUE                                                          5270
      JFIN=JFIN-1                                                       5280
      IF(NJEDIT) 76,76,73                                               5290
73    DO 75 II=1,NJEDIT                                                 5300
      IF (J-JEDIT(II)) 74,74,75                                         5310
74    JEDIT(II)=JEDIT(II)-1                                             5320
```

```
      CONTINUE                                                          5430
      JPMAX=JPVAX-1                                                     5440
      JSTAR=JSTAR-1                                                     5450
      JPLC=JPLC-1                                                       5460
      JXXO=JXXO-1                                                       5470
      DO 78 M1=1,NMTOLS                                                 5480
      IF (JRND(M1)-J+2) 78,77,77                                        5490
   77 JRND(M1)=JRND(M1)-1                                               5500
   78 CONTINUE                                                          5510
      END COLLAPS                                                       5520
   80 IF (KBZ) 81,85,80                                                 5530
   80 IF (J-JPLC) 82,81,81                                              5540
   81 IF (J+4-JPMAX) 82,84,84                                           5550
   82 J=J+1                                                             5560
      IF (J-JRND(M)) 63,83,63                                           5570
   83 M=M+1
      GO TO 63
    4 JPZ=JFINO-JFIN
      NBZ=N
      PRINT 1,TIME,N,JBZ,JSTAR
      CONTINUE
   85 IF (SCRNCH) 87,87,86
   86 CALL EDIT
   87 RETURN
      END
```

```
C     EDIT SUBROUTINE FOR THE PUFF HYDRODYNAMIC CODE                    5580
      SUBROUTINE EDIT                                                   5590
C                                                                       5600
      COMMON CS(500),CUSPI(6),CUSPA(6),CUSPC(6),CUSPD(6),CUSPG(6),      5610
     1CUSPS(6),DISCPT(12),E(500),EQSTC(6),EQSTD(6),EQSTE(6),EQSTG(      5620
     26),EQSTH(6),EQSTN(6),EQSTS(6),JBND(6),JEDIT(10),JORG(10),MATL(6),N5630
     37(20),P(500),PMIN(6),Q(500),RHO(6),RZ(20),TEDIT(25),U(500),V(500),5640
     4X(500),ZM(500)                                                    5650
      COMMON CKP,CTN,DTNH,JCK,JCYCLE,JFIN,JFIN2,JPMAX,JRZL,JSTAR,JXXO,JZP5660
     1UL,LINE,N,NJEDIT,NMTRLS,NPRIN,NRZ,NTAPE,NTEDT,PMAX,TIME,TS,UZERO,5670
     2WTAPE,ZPUL                                                        5680
C                                                                       5690
1     FORMAT(1HC6X,5HCYCLE8X,4HTIME8X,4HDTNH7X,5HJSTAR7X,5HJPMAX8X,4HPMA 5700
     1X6X,6HXJPMAX5X,7HMVPULSE6X,6HMVPREC4X,8HMOMENTUM/2X,I10,2E12.4,   5710
     22I12,5E12.4/8X4HDTPP6X,6HDTPULS6X,6HETOTAL6X,6HEMVNEG6X,6HEMVPOS5X5720
     3,7HL-BOUND4X,8HX(JBND1)4X,8HX(JBND2)5X,7HR-BOUND8X,4HJFIN/9E12.4, 5730
     4I12)                                                              5740
      FORMAT(1H1)                                                       5750
                        BINARY DATA STORAGE                             5760
      XJPMAX=X(JPMAX)                                                   5770
      IF (WTAPE) 3,7,3                                                  5780
3     JSTARD=JSTAR+1                                                    5790
      WRITE TAPE 6,N,TIME,(DISCPT(I),I=1,10),JSTAR,JFIN,JPMAX,JSTARD    5800
      IF(EOF,6) 5,4                                                     5810
4     WRITE TAPE 6,(J,X(J),U(J),P(J),Q(J),E(J),V(J),CS(J),J=1,JSTARD)    5820
      IF(EOF,6) 5,7                                                     5830
5     PRINT 6,N                                                         5840
6     FORMAT (16H NEW 06 AT CYCLE110)                                   5850
      END FILE 6                                                        5860
      REWIND 6                                                          5870
      PAUSE12345                                                        5880
      GO TO 3                                                           5890
C                                                                       5900
C                   MOMENTUM AND ENERGY CALCULATION                     5910
C                                                                       5920
7     EMVNEG=0.                                                         5930
      EMVPOS=0.                                                         5940
      ESUM=0.                                                           5950
      EKSUM=0.                                                          5960
      JSTAR1=JSTAR+1                                                    5970
      DO 11 J=2,JSTAR1                                                  5980
      EMV=ZM(J)*(U(J)+U(J-1))/2.                                        5990
      IF (EMV) 8,9,9                                                    6000
8     EMVNEG=EMVNEG+EMV                                                 6010
      GO TO 10                                                          6020
9     EMVPOS=EMVPOS+EMV                                                 6030
10    CONTINUE                                                          6040
      ESUM=ESUM+E(J)*ZM(J)/4.186E7                                      6050
      EKSUM=EKSUM+ZM(J)*(U(J)+U(J-1))**2/4.186E7/8.                     6060
11    CONTINUE                                                          6070
      ETOTAL=ESUM+EKSUM                                                 6080
      JM=JPMAX+3                                                        6090
      EMVPL=0.                                                          6100
12    EMVPL=EMVPL+U(JM)*.5*(ZM(JM+1)+ZM(JM))                            6110
      IF(JM-JPMAX) 13,14,14                                             6120
13    IF(U(JM-1)) 16,16,14                                              6130
14    IF (JM-1) 15,16,15                                                6140
```

```
15      JM=JM-1                                                                 6150
        GO TO 12                                                                6160
16      JM=JPMAX+4                                                              6170
        EMVPR=0.                                                                6180
17      EMVPR=EMVPR+U(JM)/2.*(ZM(JM)+ZM(JM+1))                                  6190
        IF (JM-JFIN) 18,18,19                                                   6200
18      JM=JM+1                                                                 6210
        GO TO 17                                                                6220
19      EMVPR=EMVPL+EMVPR                                                       6230
        DTPR=EMVPR/PMAX                                                         6240
        DTPULS=EMVPL/PMAX                                                       6250
C                                                                               6260
C                       PRINT OUTPUT VARIABLES                                  6270
C                                                                               6280
        JBND1=JBND(1)                                                           6290
        JBND2=JBND(2)                                                           6300
        PRINT 1,N,TIME,DTNH,JSTAR,JPMAX,PMAX,XJPMAX,EMVPL,EMVPR,EMVPR,DTPR      6310
       1,DTPULS,DTOTAL,EMVNEG,EMVPOS,X(1),X(JBND1),X(JBND2),X(JFIN),JFIN        6320
        LINE=LINE+5                                                             6330
        IF(XMODF(LINE,50)) 21,20,21                                             6340
20      PRINT 2                                                                 6350
21      RETURN                                                                  6360
        END                                                                     6370
```

```
C     EQUATION OF STATE SUBROUTINE FOR THE PUFF HYDRODYNAMIC CODE                6330
      SUBROUTINE EQST (E1,D,P1,M)                                                6340
C                                                                                6350
      COMMON CS(500),CUSP1(6),CUSPA(6),CUSPC(6),CUSPD(6),CUSPG(6),               6360
     1CUSPS(6),DISCPT(12),E(500),EQSTC(6),EQSTD(6),EQSTE(6),EQSTG(               6370
     26),EQSTH(6),EQSTN(6),EQSTS(6),JBND(6),JEDIT(10),JORG(10),MATL(6),          6380
     3Z(20),P(500),PMIN(6),Q(500),RHO(6),R7(20),TEDIT(25),U(500),V(500),         6390
     4X(500),ZM(500)                                                             6400
      COMMON CMP,DTN,DTNH,JCK,JCYCS,JFIN,JFIN2,JPMAX,JRZL,JSTAR,JXXO,JZP         6410
     1UL,LINE,N,NJEDIT,NMTRLS,NPRIN,NRZ,NTAPE,NTEDT,PMAX,TIME,TS,UZERO,         6420
     2WTAPE,ZPNL                                                                 6430
      ENU=D/RHO(M)                                                               6440
      EMU=ENU-1.                                                                 6450
      V1=RHO(M)/D                                                                6460
      IF (EMU) 1,5,5                                                             6470
C                                                                                6480
C                          VAPOR EQUATION                                        6490
C                                                                                6500
    1 ENU2=EQSTN(M)*(1.-V1)*V1                                                   6510
      IF (ENU2+10.) 3,3,2                                                        6520
    2 T1=EQSTE(M)*(1.-EXPF(ENU2))                                                6530
      GO TO 4                                                                    6540
    3 T1=EQSTE(M)                                                                6550
    4 T2=ENU*(EQSTH(M)+(EQSTG(M)-EQSTH(M))*SQRTF(ENU))                           6560
      P1=MAXIF(PMIN(M),(E1-T1)*T2*RHO(M))                                        6570
      GO TO 9                                                                    6580
C                                                                                6590
C                    TWO-WAVE SOLID EQUATION                                     6600
C                                                                                6610
    5 IF(CUSPA(M)) 8,8,6                                                         6620
    6 ARG=EMU-CUSPA(M)                                                           6630
      IF(ARG) 8,8,7                                                              6640
    7 T2=((CUSPS(M)*ARG+CUSPD(M))*ARG+CUSPC(M))*ARG                              6650
      P1=CUSP1(M)+T2+E1*CUSPG(M)*D                                               6660
      GO TO 9                                                                    6670
C                                                                                6680
C                    ONE-WAVE SOLID EQUATION                                     6690
C                                                                                6700
    8 T2=((EQSTS(M)*EMU+EQSTD(M))*EMU+EQSTC(M))*EMU                              6710
      P1=T2+E1*EQSTC(M)*D                                                        6720
    9 RETURN                                                                     6730
      END                                                                        6740
```

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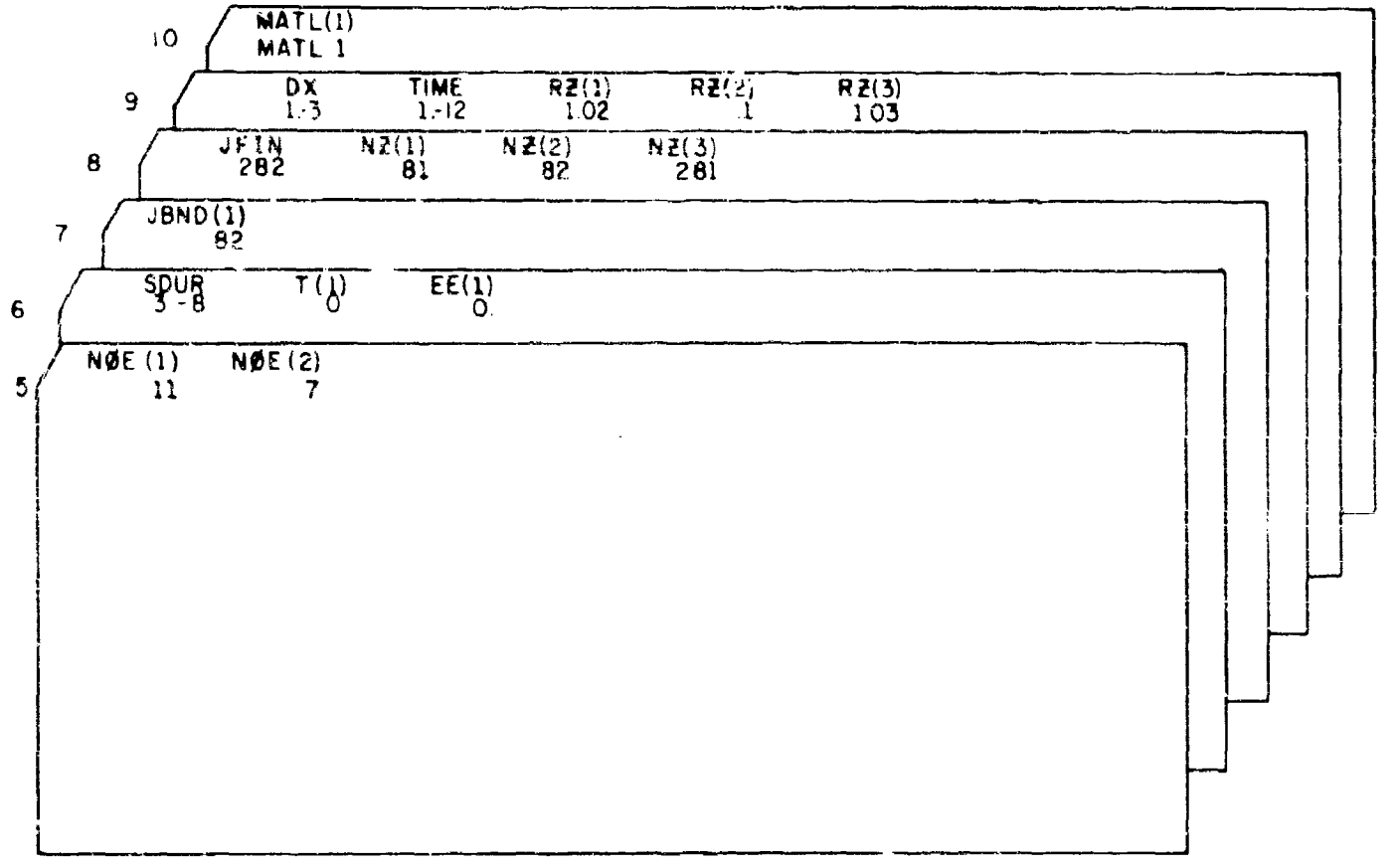
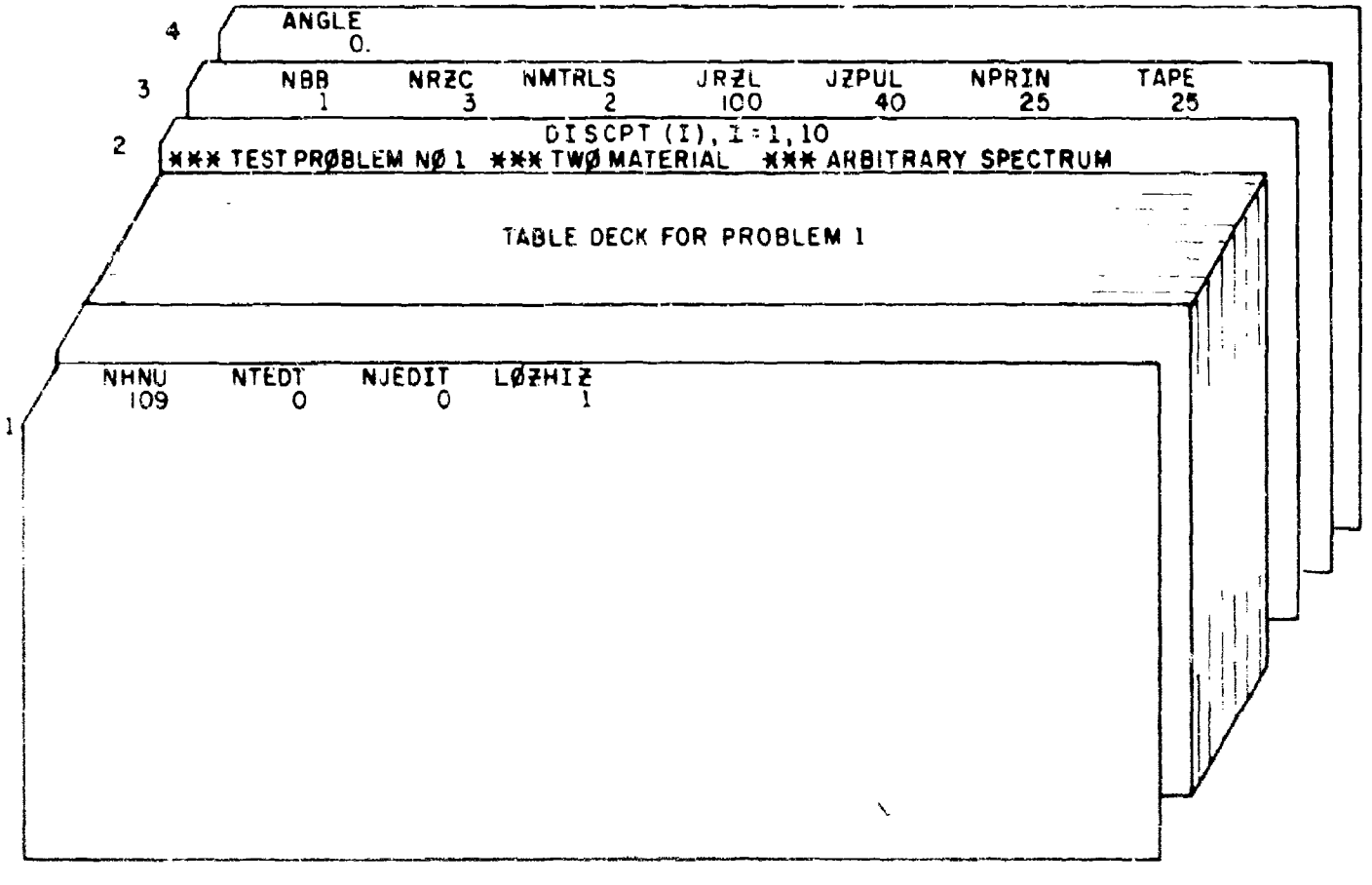
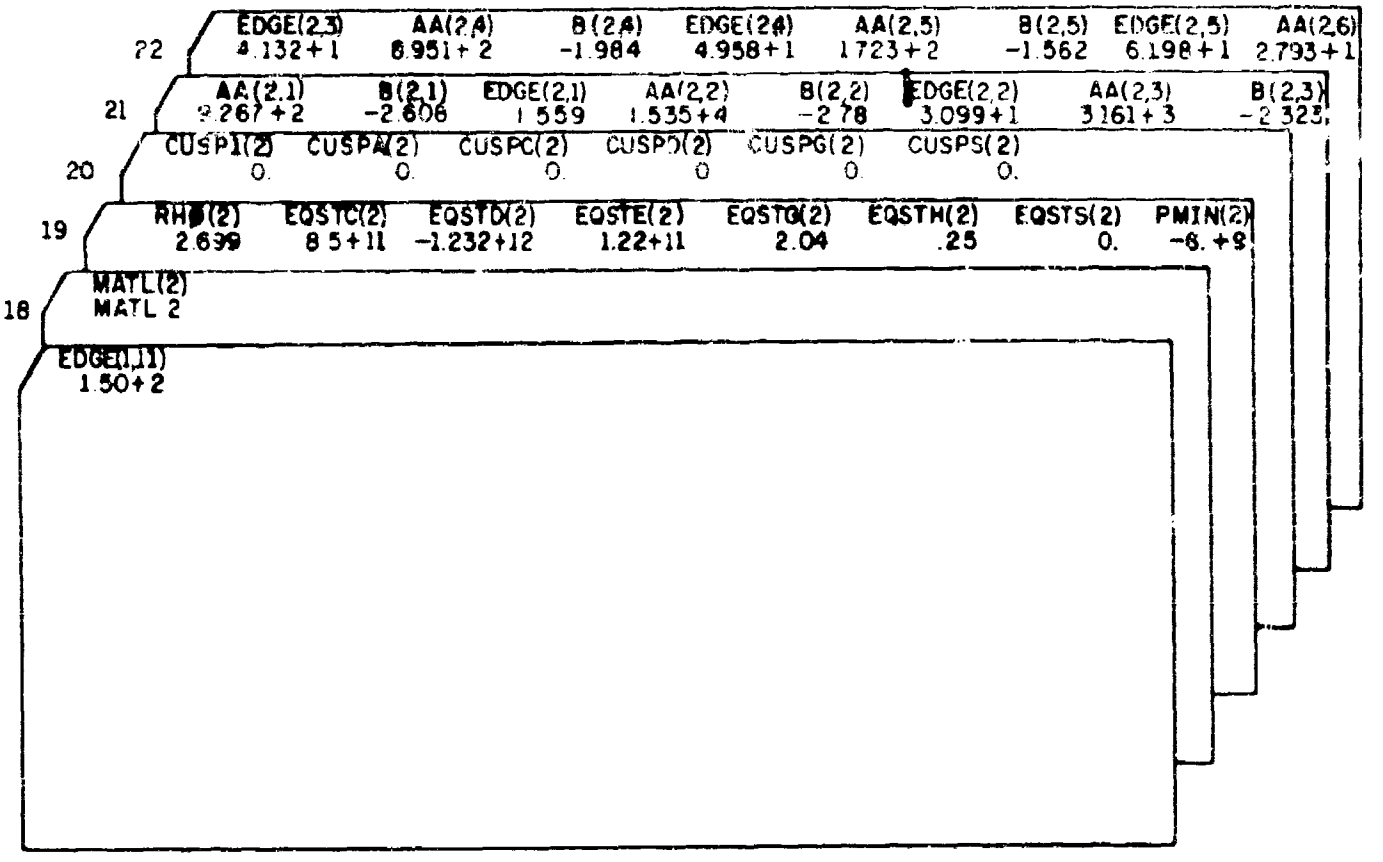
APPENDIX III

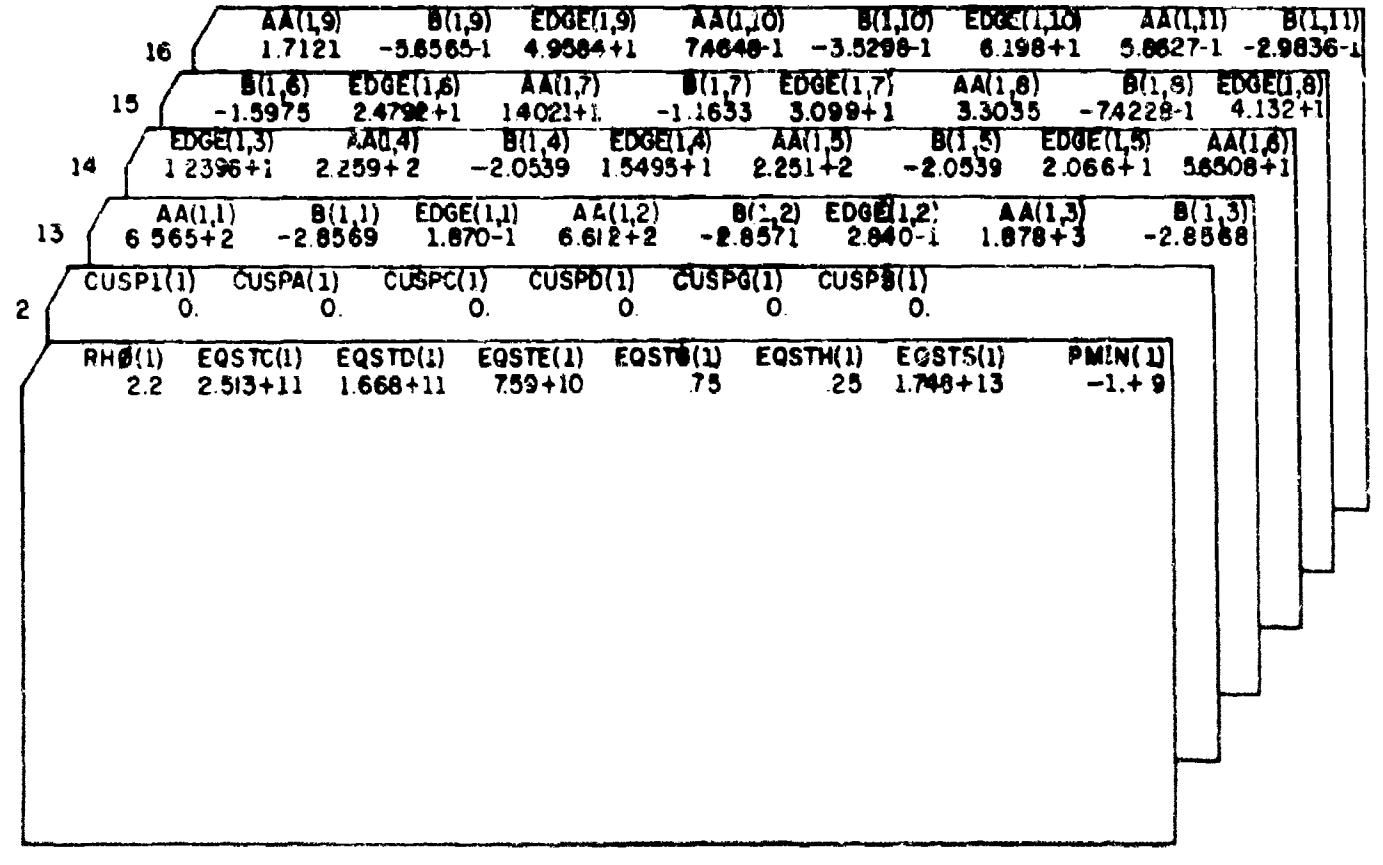
TEST PROBLEM 1

(PUFF)


10
MATL(I)
MATL 1
9
DX
1.-3
TIME
1.-12
RZ(1)
1.02
RZ(2)
1
RZ(3)
1.03
8
JFIN
282
NZ(1)
81
NZ(2)
82
NZ(3)
281
7
JBND(I)
82
6
SDUR
3.-8
T(1)
0.
EE(1)
0.
5
NØE(1)
11
NØE(2)
7


4
ANGLE
0.
3
NBB
1
NRZC
3
NMTRLS
2
JRZL
100
JZPUL
40
NPRIN
25
TAPE
25
2
DISCPT(I), I=1,10
*** TEST PRØBLEM NØ 1 *** TWØ MATERIAL *** ARBITRARY SPECTRUM
TABLE DECK FOR PROBLEM 1
1
NHNU
109
NTEDT
0
NJEDIT
0
LØZHIZ
1


22
EDGE(2,3) AA(2,4) B(2,4) EDGE(2,4) AA(2,5) B(2,5) EDGE(2,5) AA(2,6)
4.132+1 6.951+2 -1.984 4.958+1 1.723+2 -1.562 6.198+1 2.793+1
21
AA(2,1) B(2,1) EDGE(2,1) AA(2,2) B(2,2) EDGE(2,2) AA(2,3) B(2,3)
9.267+2 -2.606 1.559 1.535+4 -2.78 3.099+1 3.161+3 -2.323
20
CUSPI(2) CUSPA(2) CUSPC(2) CUSPD(2) CUSPG(2) CUSPS(2)
0. 0. 0. 0 0. 0.
19
RHØ(2) EQSTC(2) EQSTD(2) EQSTE(2) EQSTG(2) EQSTH(2) EQSTS(2) PMIN(2)
2.699 8.5+11 -1.232+12 1.22+11 2.04 .25 0. -6.+8
18
MATL(2)
MATL 2
EDGE(1,11)
1.50+2


16
AA(1,9) B(1,9) EDGE(1,9) AA(1,10) B(1,10) EDGE(1,10) AA(1,11) B(1,11)
1.7121 -5.6565-1 4.9584+1 7.4648-1 -3.5298-1 6.198+1 5.8627-1 -2.9836-1
15
B(1,6) EDGE(1,6) AA(1,7) B(1,7) EDGE(1,7) AA(1,8) B(1,8) EDGE(1,8)
-1.5975 2.4792+1 1.4021+1 -1.1633 3.099+1 3.3035 -7.4228-1 4.132+1
14
EDGE(1,3) AA(1,4) B(1,4) EDGE(1,4) AA(1,5) B(1,5) EDGE(1,5) AA(1,6)
1.2396+1 2.259+2 -2.0539 1.5495+1 2.251+2 -2.0539 2.066+1 5.6508+1
13
AA(1,1) B(1,1) EDGE(1,1) AA(1,2) B(1,2) EDGE(1,2) AA(1,3) B(1,3)
6.565+2 -2.8569 1.870-1 6.612+2 -2.8571 2.840-1 1.878+3 -2.8568
2
CUSPI(1) CUSPA(1) CUSPC(1) CUSPD(1) CUSPG(1) CUSPS(1)
0. 0. 0. 0. 0. 0.
RHØ(1) EQSTC(1) EQSTD(1) EQSTE(1) EQSTG(1) EQSTH(1) EQSTS(1) PMIN(1)
2.2 2.513+11 1.668+11 7.59+10 .75 .25 1.748+13 -1.+9

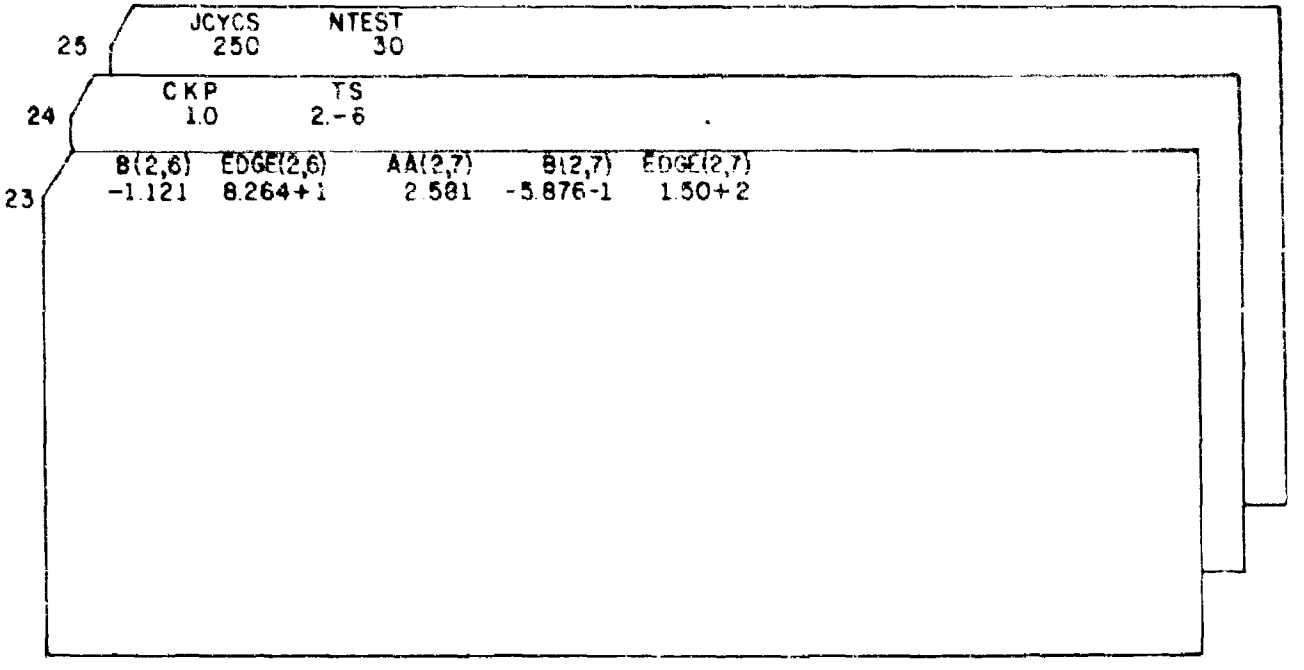

25
JCYCS
250
NTEST
30
24
CKP
1.0
TS
2.-6
23
B(2,6)
-1.121
EDGE(2,6)
8.264+1
AA(2,7)
2.581
B(2,7)
-5.876-1
EDGE(2,7)
1.50+2

TABLE DECK FOR TEST PROBLEM 1

2E15.7 FORMAT

TBL(I)	LI(I)	TBL CARD #
0.5972897E 00	0.	1
0.7712318E 00	0.	2
0.8991189E 00	0.	3
0.1004823E 01	0.	4
0.1097018E 01	0.	5
0.1179999E 01	0.	6
0.1256234E 01	0.	7
0.1327283E 01	0.	8
0.1394228E 01	0.	9
0.1457829E 01	0.	10
0.1518656E 01	0.	11
0.1577137E 01	0.	12
0.1633631E 01	0.	13
0.1688417E 01	0.	14
0.1741701E 01	0.	15
0.1793693E 01	0.	16
0.1844536E 01	0.	17
0.1894372E 01	0.5026790E-30	18
0.1943309E 01	0.9455565E-28	19
0.1991455E 01	0.1016467E-25	20
0.2038900E 01	0.6780110E-24	21
0.2085728E 01	0.3002525E-22	22
0.2132004E 01	0.9325856E-21	23
0.2177796E 01	0.2127423E-19	24
0.2223151E 01	0.3701496E-18	25
0.2268135E 01	0.5078059E-17	26
0.2312798E 01	0.5645669E-16	27
0.2357167E 01	0.5202916E-15	28
0.2401296E 01	0.4058228E-14	29
0.2445216E 01	0.2725063E-13	30
0.2488976E 01	0.1600093E-12	31
0.2532594E 01	0.8319149E-12	32
0.2576116E 01	0.3876429E-11	33
0.2619573E 01	0.1635183E-10	34
0.2662981E 01	0.6297824E-10	35
0.2706380E 01	0.2233014E-09	36
0.2749789E 01	0.7338907E-09	37
0.2793255E 01	0.2250884E-08	38
0.2836786E 01	0.6475984E-08	39
0.2880413E 01	0.1756749E-07	40

TBL(I)	EI(I)	TBL CELL #
0.2924104E 01	0.4513999E-07	41
0.2968066E 01	0.1103210E-06	42
0.3012138E 01	0.2573599E-06	43
0.3056410E 01	0.5750408E-06	44
0.3100917E 01	0.1234469E-05	45
0.3146668E 01	0.2553269E-05	46
0.3190700E 01	0.5100153E-05	47
0.3236046E 01	0.9863331E-05	48
0.3281714E 01	0.1850221E-04	49
0.3327763E 01	0.3374433E-04	50
0.3374200E 01	0.5992323E-04	51
0.3421056E 01	0.1037839E-03	52
0.3468368E 01	0.1755874E-03	53
0.3516174E 01	0.2906129E-03	54
0.3564503E 01	0.4711179E-03	55
0.3613382E 01	0.7489089E-03	56
0.3662859E 01	0.1168785E-02	57
0.3712972E 01	0.1792640E-02	58
0.3763772E 01	0.2704874E-02	59
0.3815276E 01	0.4017908E-02	60
0.3867541E 01	0.5881003E-02	61
0.3920633E 01	0.8489057E-02	62
0.3974590E 01	0.1209454E-01	63
0.4029484E 01	0.1701714E-01	64
0.4085365E 01	0.2366088E-01	65
0.4142310E 01	0.3253191E-01	66
0.4200384E 01	0.4425427E-01	67
0.4259677E 01	0.5959707E-01	68
0.4320261E 01	0.7948911E-01	69
0.4382229E 01	0.1050552E-00	70
0.4445692E 01	0.1376467E-00	71
0.4510757E 01	0.1788674E-00	72
0.4577551E 01	0.2306213E-00	73
0.4646193E 01	0.2951281E-00	74
0.4716850E 01	0.3750174E-00	75
0.4789699E 01	0.4733590E-00	76
0.4864916E 01	0.5936806E 00	77
0.4942714E 01	0.7400929E 00	78
0.5023361E 01	0.9173987E 00	79
0.5107114E 01	0.1131043E 01	80
0.5194313E 01	0.1387413E 01	81
0.5285303E 01	0.1693737E 01	82
0.5380537E 01	0.2058509E 01	83
0.5480544E 01	0.2491589E 01	84
0.5585897E 01	0.3004178E 01	85

TBL(I)	LI(I)	TBL C/M #
0.5697338E 01	0.3609566E 01	86
0.5815793E 01	0.4323557E 01	87
0.5942340E 01	0.5164528E 01	88
0.6078354E 01	0.6154630E 01	89
0.6225589E 01	0.7320720E 01	90
0.6388413E 01	0.8696869E 01	91
0.6563949E 01	0.1032499E 02	92
0.6762600E 01	0.1226171E 02	93
0.6988700E 01	0.1458224E 02	94
0.7252136E 01	0.1739563E 02	95
0.7559328E 01	0.2086893E 02	96
0.7970381E 01	0.2528069E 02	97
0.8523455E 01	0.3119787E 02	98
0.9445122E 01	0.4017112E 02	99
0.9582477E 01	0.4139209E 01	100
0.9735226E 01	0.4271261E 01	101
0.9907640E 01	0.4415586E 01	102
0.1010589E 02	0.4575365E 01	103
0.1033809E 02	0.4690531E 01	104
0.1062301E 02	0.4836915E 01	105
0.1098729E 02	0.5014182E 01	106
0.1149872E 02	0.5244522E 01	107
0.1237049E 02	0.5593458E 01	108
0.1425600E 02	0.6181078E 01	109

INPUT PARAMETERS FOR - -

** TEST PROBLEM NO. 1 *** TWO MATERIAL *** ARBITRARY SPECTRUM
***** THIS PROBLEM WAS RUN ON PUFF/1604 *****
TABLE VALUES
5.973E-01 7.712E-01 8.991E-01 1.005E 00 1.097E 00 1.180E 00 1.256E 00 1.327E 00 1.394E 00 1.458E 00

1.519E 00 1.577E 00 1.634E 00 1.688E 00 1.742E 00 1.794E 00 1.845E 00 1.894E 00 1.943E 00 1.991E 00

2.039E 00 2.086E 00 2.132E 00 2.178E 00 2.223E 00 2.268E 00 2.313E 00 2.357E 00 2.401E 00 2.445E 00

2.489E 00 2.533E 00 2.576E 00 2.620E 00 2.663E 00 2.706E 00 2.750E 00 2.793E 00 2.837E 00 2.880E 00

2.924E 00 2.968E 00 3.012E 00 3.056E 00 3.101E 00 3.146E 00 3.191E 00 3.236E 00 3.282E 00 3.328E 00

3.374E 00 3.421E 00 3.468E 00 3.516E 00 3.565E 00 3.613E 00 3.663E 00 3.713E 00 3.764E 00 3.815E 00

3.868E 00 3.921E 00 3.975E 00 4.029E 00 4.085E 00 4.142E 00 4.200E 00 4.260E 00 4.320E 00 4.382E 00

4.446E 00 4.511E 00 4.578E 00 4.646E 00 4.717E 00 4.790E 00 4.865E 00 4.943E 00 5.023E 00 5.107E 00

5.194E 00 5.285E 00 5.381E 00 5.481E 00 5.586E 00 5.697E 00 5.816E 00 5.942E 00 6.078E 00 6.226E 00

6.386E 00 6.564E 00 6.763E 00 6.989E 00 7.252E 00 7.569E 00 7.970E 00 8.523E 00 9.445E 00 9.582E 00

9.735E 00 9.908E 00 1.011E 01 1.034E 01 1.062E 01 1.099E 01 1.150E 01 1.238E 01 1.425E 01

NBB	NRZC	NMTRLS	JRZL	JZPUL	NPRIN	ANGLE
1	3	2	100	40	25	1.000E 00

EITOT = 2.7242272E 02

LOZHIZ = 1

ZONING CONSTANTS

RATIO 1.020E 00 TO ZONE 81
RATIO 1.000E-01 TO ZONE 82
RATIO 1.030E 00 TO ZONE 281

BLACK BODY TEMPERATURE AND ASSOCIATED ENERGY

TEMPERATURE	ENERGY
0	0

JFIN	JCYCS	NTEST	NTAPE	CKP	TS	TIME	SDUR
282	250	30	25	1.000E 00	2.000E-06	1.000E-12	3.000E-08

MATERIAL PROPERTIES FOR MATL 1 RHO= 2.200E 00 FROM J= 1 TO J= 82
MATERIAL THICKNESS = 1.986E-01

EQSTC	EQSTD	EQSTE	EQSTG	EQSTH	EQSTS	EQSTN	PMIN
2.51300E 11	1.66800E 11	7.59000E 10	7.50000E-01	2.50000E-01	1.74800E 13	2.00663E 00	-1.00000E 09

NOE= 11	AA	B	EDGE
	6.56500E 02	-2.85690E 00	1.87000E-01
	6.61200E 02	-2.85710E 00	2.84000E-01
	1.87800E 03	-2.85680E 00	1.23960E 01
	2.25900E 02	-2.05390E 00	1.54950E 01
	2.25100E 02	-2.05390E 00	2.06600E 01
	5.65080E 01	-1.59750E 00	2.47920E 01
	1.40210E 01	-1.16330E 00	3.09900E 01
	3.30350E 00	-7.42280E-01	4.13200E 01
	1.71210E 00	-5.65650E-01	4.95840E 01
	7.46480E-01	-3.52980E-01	6.19800E 01
	5.86270E-01	-2.99360E-01	1.50000E 02

MATERIAL PROPERTIES FOR MATL 2 RHO= 2.699E 00 FROM J= 82 TO J= 282
MATERIAL THICKNESS = 5.986E 00

EQSTC	EQSTD	EQSTE	EQSTG	EQSTH	EQSTS	EQSTN	PMIN
8.50000E 11	-1.23200E 12	1.22000E 11	2.04000E 00	2.50000E-01	0	1.26539E 00	-6.00000E 09

NOE= 7	AA	B	EDGE
	9.26700E 02	-2.60800E 00	1.55900E 00
	1.53500E 04	-2.78000E 00	3.09900E 01
	3.16100E 03	-2.32300E 00	4.13200E 01
	8.95100E 02	-1.98400E 00	4.95800E 01
	1.72300E 02	-1.56200E 00	6.19800E 01
	2.79300E 01	-1.12100E 00	8.26400E 01
	2.58100E 00	-5.87600E-01	1.50000E 02

*** TEST PROBLEM NO. 1 *** TWO MATERIAL *** ARBITRARY SPECTRUM

J	DX	X	ERGS	CAL	SUM CAL	ERGS/GM	VELOCITY	ZONE MASS	J
2	1.00000E-0[illegible]	1.00000E-03	1.52023E 08	3.63171E 00	3.63171E 00	6.91015E 10	0	2.20000E-03	2
3	1.02000E-03	2.02000E-03	1.52081E 08	3.63308E 00	7.26479E 00	6.77721E 10	0	2.24400E-03	3
4	1.04040E-03	3.06040E-03	1.52099E 08	3.63352E 00	1.08983E 01	6.64514E 10	0	2.28888E-03	4
5	1.06121E-03	4.12161E-03	1.52079E 08	3.63304E 00	1.45313E 01	6.51398E 10	0	2.33466E-03	5
6	1.08243E-03	5.20404E-03	1.52020E 08	3.63163E 00	1.81630E 01	6.38377E 10	0	2.38135E-03	6
7	1.10408E-03	6.30812E-03	1.51921E 08	3.62928E 00	2.17922E 01	6.25454E 10	0	2.42898E-03	7
8	1.12616E-03	7.43428E-03	1.51784E 08	3.62598E 00	2.54182E 01	6.12634E 10	0	2.47756E-03	8
9	1.14869E-03	8.58297E-03	1.51606E 08	3.62174E 00	2.90400E 01	5.99919E 10	0	2.52711E-03	9
10	1.17166E-03	9.75463E-03	1.51389E 08	3.61656E 00	3.26565E 01	5.87314E 10	0	2.57765E-03	10
11	1.19509E-03	1.09497E-02	1.51132E 08	3.61042E 00	3.62669E 01	5.74821E 10	0	2.62920E-03	11
12	1.21899E-03	1.21687E-02	1.50835E 08	3.60333E 00	3.98703E 01	5.62443E 10	0	2.68179E-03	12
13	1.24337E-03	1.34121E-02	1.50499E 08	3.59528E 00	4.34656E 01	5.50184E 10	0	2.73542E-03	13
14	1.26824E-03	1.46803E-02	1.50122E 08	3.58629E 00	4.70518E 01	5.38047E 10	0	2.79013E-03	14
15	1.29361E-03	1.59739E-02	1.49706E 08	3.57635E 00	5.06282E 01	5.26034E 10	0	2.84593E-03	15
16	1.31948E-03	1.72934E-02	1.49250E 08	3.56546E 00	5.41937E 01	5.14149E 10	0	2.90285E-03	16
17	1.34587E-03	1.86393E-02	1.48755E 08	3.55362E 00	5.77473E 01	5.02395E 10	0	2.96091E-03	17
18	1.37279E-03	2.00121E-02	1.48220E 08	3.54085E 00	6.12881E 01	4.90774E 10	0	3.02013E-03	18
19	1.40024E-03	2.14123E-02	1.47646E 08	3.52714E 00	6.48153E 01	4.79288E 10	0	3.08053E-03	19
20	1.42825E-03	2.28406E-02	1.47033E 08	3.51250E 00	6.83278E 01	4.67940E 10	0	3.14214E-03	20
21	1.45681E-03	2.42974E-02	1.46382E 08	3.49694E 00	7.18247E 01	4.56732E 10	0	3.20498E-03	21
22	1.48595E-03	2.57833E-02	1.45692E 08	3.48047E 00	7.53052E 01	4.45667E 10	0	3.26908E-03	22
23	1.51567E-03	2.72990E-02	1.44965E 08	3.46309E 00	7.87683E 01	4.34747E 10	0	3.33447E-03	23
24	1.54598E-03	2.88450E-02	1.44200E 08	3.44482E 00	8.22131E 01	4.23974E 10	0	3.40116E-03	24
25	1.57690E-03	3.04219E-02	1.43398E 08	3.42566E 00	8.56387E 01	4.13348E 10	0	3.46918E-03	25
26	1.60844E-03	3.20303E-02	1.42559E 08	3.40562E 00	8.90444E 01	4.02874E 10	0	3.53856E-03	26
27	1.64061E-03	3.36709E-02	1.41685E 08	3.38473E 00	9.24291E 01	3.92551E 10	0	3.60933E-03	27
28	1.67342E-03	3.53443E-02	1.40774E 08	3.36298E 00	9.57921E 01	3.82381E 10	0	3.68152E-03	28
29	1.70689E-03	3.70512E-02	1.39829E 08	3.34040E 00	9.91325E 01	3.72366E 10	0	3.75515E-03	29
30	1.74102E-03	3.87922E-02	1.38850E 08	3.31700E 00	1.02449E 02	3.62508E 10	0	3.83025E-03	30
31	1.77584E-03	4.05681E-02	1.37836E 08	3.29279E 00	1.05742E 02	3.52806E 10	0	3.90686E-03	31
32	1.81136E-03	4.23794E-02	1.36790E 08	3.26780E 00	1.09010E 02	3.43262E 10	0	3.98500E-03	32
33	1.84759E-03	4.42270E-02	1.35711E 08	3.24203E 00	1.12252E 02	3.33878E 10	0	4.06470E-03	33
34	1.88454E-03	4.61116E-02	1.34601E 08	3.21550E 00	1.15468E 02	3.24653E 10	0	4.14599E-03	34
35	1.92223E-03	4.80338E-02	1.33460E 08	3.18824E 00	1.18656E 02	3.15589E 10	0	4.22891E-03	35
36	1.96068E-03	4.99945E-02	1.32289E 08	3.16026E 00	1.21816E 02	3.06686E 10	0	4.31349E-03	36
37	1.99989E-03	5.19944E-02	1.31089E 08	3.13158E 00	1.24948E 02	2.97944E 10	0	4.39976E-03	37
38	2.03989E-03	5.40343E-02	1.29859E 08	3.10223E 00	1.28050E 02	2.89364E 10	0	4.48775E-03	38
39	2.08069E-03	5.61149E-02	1.28603E 08	3.07221E 00	1.31122E 02	2.80945E 10	0	4.57751E-03	39
40	2.12230E-03	5.82372E-02	1.27320E 08	3.04156E 00	1.34164E 02	2.72688E 10	0	4.66906E-03	40
41	2.16474E-03	6.04020E-02	1.26011E 08	3.01029E 00	1.37174E 02	2.64593E 10	0	4.76244E-03	41
42	2.20804E-03	6.26100E-02	1.24677E 08	2.97843E 00	1.40152E 02	2.56659E 10	0	4.85769E-03	42
43	2.25220E-03	6.48622E-02	1.23319E 08	2.94600E 00	1.43098E 02	2.48887E 10	0	4.95484E-03	43
44	2.29724E-03	6.71595E-02	1.21939E 08	2.91302E 00	1.46011E 02	2.41275E 10	0	5.05394E-03	44
45	2.34319E-03	6.95027E-02	1.20536E 08	2.87951E 00	1.48891E 02	2.33823E 10	0	5.15502E-03	45
46	2.39005E-03	7.18927E-02	1.19113E 08	2.84551E 00	1.51736E 02	2.26531E 10	0	5.25812E-03	46
47	2.43785E-03	7.43306E-02	1.17669E 08	2.81102E 00	1.54547E 02	2.19398E 10	0	5.36328E-03	47
48	2.48661E-03	7.68172E-02	1.16207E 08	2.77609E 00	1.57324E 02	2.12423E 10	0	5.47054E-03	48
49	2.53634E-03	7.93535E-02	1.14727E 08	2.74073E 00	1.60064E 02	2.05605E 10	0	5.57996E-03	49
50	2.58707E-03	8.19406E-02	1.13230E 08	2.70496E 00	1.62769E 02	1.98943E 10	0	5.69155E-03	50

*** TEST PROBLEM NO. 1 *** TWO MATERIAL *** ARBITRARY SPECTRUM

J	DX	X	ERGS	CAL	SUM CAL	ERGS/GM	VELOCITY	ZONE MASS	J
51	2.63881E-03	8.45794E-02	1.11717E 08	2.66881E 00	1.65438E 02	1.92436E 10	0	5.80539E-03	51
52	2.69159E-03	8.72710E-02	1.10189E 08	2.63231E 00	1.68070E 02	1.86083E 10	0	5.92149E-03	52
53	2.74542E-03	9.00164E-02	1.08647E 08	2.59549E 00	1.70666E 02	1.79882E 10	0	6.03992E-03	53
54	2.80033E-03	9.28167E-02	1.07093E 08	2.55836E 00	1.73224E 02	1.73832E 10	0	6.16072E-03	54
55	2.85633E-03	9.56731E-02	1.05527E 08	2.52095E 00	1.75745E 02	1.67931E 10	0	6.28394E-03	55
56	2.91346E-03	9.85865E-02	1.03950E 08	2.48329E 00	1.78228E 02	1.62179E 10	0	6.40962E-03	56
57	2.97173E-03	1.01558E-01	1.02364E 08	2.44540E 00	1.80674E 02	1.56573E 10	0	6.53781E-03	57
58	3.03117E-03	1.04589E-01	1.00770E 08	2.40730E 00	1.83081E 02	1.51111E 10	0	6.66856E-03	58
59	3.09179E-03	1.07681E-01	9.91676E 07	2.36903E 00	1.85450E 02	1.45793E 10	0	6.80193E-03	59
60	3.15362E-03	1.10835E-01	9.75592E 07	2.33061E 00	1.87781E 02	1.40616E 10	0	6.93797E-03	60
61	3.21670E-03	1.14052E-01	9.59453E 07	2.29205E 00	1.90073E 02	1.35579E 10	0	7.07673E-03	61
62	3.28103E-03	1.17333E-01	9.43271E 07	2.25339E 00	1.92326E 02	1.30678E 10	0	7.21827E-03	62
63	3.34665E-03	1.20679E-01	9.27055E 07	2.21466E 00	1.94541E 02	1.25913E 10	0	7.36263E-03	63
64	3.41358E-03	1.24093E-01	9.10815E 07	2.17586E 00	1.96717E 02	1.21282E 10	0	7.50989E-03	64
65	3.48186E-03	1.27575E-01	8.94562E 07	2.13703E 00	1.98854E 02	1.16782E 10	0	7.66008E-03	65
66	3.55149E-03	1.31126E-01	8.78305E 07	2.09820E 00	2.00952E 02	1.12412E 10	0	7.81329E-03	66
67	3.62252E-03	1.34749E-01	8.62053E 07	2.05937E 00	2.03011E 02	1.08168E 10	0	7.96955E-03	67
68	3.69497E-03	1.38444E-01	8.45817E 07	2.02058E 00	2.05032E 02	1.04050E 10	0	8.12894E-03	68
69	3.76887E-03	1.42213E-01	8.29605E 07	1.98186E 00	2.07014E 02	1.00055E 10	0	8.29152E-03	69
70	3.84425E-03	1.46057E-01	8.13426E 07	1.94321E 00	2.08957E 02	9.61798E 09	0	8.45735E-03	70
71	3.92114E-03	1.49978E-01	7.97290E 07	1.90466E 00	2.10862E 02	9.24234E 09	0	8.62650E-03	71
72	3.99956E-03	1.53977E-01	7.81206E 07	1.86623E 00	2.12728E 02	8.87832E 09	0	8.79903E-03	72
73	4.07955E-03	1.58057E-01	7.65181E 07	1.82795E 00	2.14556E 02	8.52569E 09	0	8.97501E-03	73
74	4.16114E-03	1.62218E-01	7.49224E 07	1.78983E 00	2.16346E 02	8.18421E 09	0	9.15451E-03	74
75	4.24436E-03	1.66463E-01	7.33344E 07	1.75190E 00	2.18098E 02	7.85367E 09	0	9.33760E-03	75
76	4.32925E-03	1.70792E-01	7.17549E 07	1.71416E 00	2.19812E 02	7.53383E 09	0	9.52435E-03	76
77	4.41584E-03	1.75208E-01	7.01845E 07	1.67665E 00	2.21488E 02	7.22447E 09	0	9.71484E-03	77
78	4.50415E-03	1.79712E-01	6.86241E 07	1.63937E 00	2.23128E 02	6.92534E 09	0	9.90913E-03	78
79	4.59424E-03	1.84306E-01	6.70745E 07	1.60235E 00	2.24730E 02	6.63623E 09	0	1.01073E-02	79
80	4.68612E-03	1.88992E-01	6.55362E 07	1.56560E 00	2.26296E 02	6.35690E 09	0	1.03095E-02	80
81	4.77984E-03	1.93772E-01	6.40100E 07	1.52915E 00	2.27825E 02	6.08712E 09	0	1.05157E-02	81
82	4.87544E-03	1.98647E-01	6.24966E 07	1.49299E 00	2.29318E 02	5.82667E 09	0	1.07260E-02	82
83	4.87544E-04	1.99135E-01	7.06529E 07	1.68879E 00	2.31007E 02	5.37229E 10	0	1.31588E-03	83
84	5.02170E-04	1.99637E-01	6.91742E 07	1.65251E 00	2.32659E 02	5.10376E 10	0	1.35536E-03	84
85	5.17235E-04	2.00154E-01	6.76286E 07	1.61559E 00	2.34275E 02	4.84439E 10	0	1.39602E-03	85
86	5.32752E-04	2.00687E-01	6.60588E 07	1.57809E 00	2.35853E 02	4.59412E 10	0	1.43790E-03	86
87	5.48735E-04	2.01236E-01	6.44675E 07	1.54007E 00	2.37393E 02	4.35287E 10	0	1.48104E-03	87
88	5.65197E-04	2.01801E-01	6.28575E 07	1.50161E 00	2.38894E 02	4.12054E 10	0	1.52547E-03	88
89	5.82153E-04	2.02383E-01	6.12316E 07	1.46277E 00	2.40357E 02	3.89705E 10	0	1.57123E-03	89
90	5.99618E-04	2.02983E-01	5.95925E 07	1.42361E 00	2.41781E 02	3.68226E 10	0	1.61837E-03	90
91	6.17606E-04	2.03600E-01	5.79431E 07	1.38421E 00	2.43165E 02	3.47606E 10	0	1.66692E-03	91
92	6.36134E-04	2.04237E-01	5.62860E 07	1.34463E 00	2.44510E 02	3.27830E 10	0	1.71693E-03	92
93	6.55218E-04	2.04892E-01	5.46241E 07	1.30492E 00	2.45815E 02	3.08884E 10	0	1.76843E-03	93
94	6.74875E-04	2.05567E-01	5.29601E 07	1.26517E 00	2.47080E 02	2.90752E 10	0	1.82149E-03	94
95	6.95121E-04	2.06262E-01	5.12967E 07	1.22544E 00	2.48305E 02	2.73418E 10	0	1.87613E-03	95
96	7.15975E-04	2.06978E-01	4.96367E 07	1.18578E 00	2.49491E 02	2.56863E 10	0	1.93242E-03	96
97	7.37454E-04	2.07715E-01	4.79825E 07	1.14626E 00	2.50637E 02	2.41071E 10	0	1.99039E-03	97
98	7.59578E-04	2.08475E-01	4.63368E 07	1.10695E 00	2.51744E 02	2.26022E 10	0	2.05010E-03	98
99	7.82365E-04	2.09257E-01	4.47021E 07	1.06789E 00	2.52812E 02	2.11697E 10	0	2.11160E-03	99
100	8.05836E-04	2.10063E-01	4.30808E 07	1.02916E 00	2.53841E 02	1.98077E 10	0	2.17495E-03	100

*** TEST PROBLEM NO. 1 *** TWO MATERIAL *** ARBITRARY SPECTRUM

J	DX	X	ERGS	CAL	SUM CAL	ERGS/GM	VELOCITY	ZONE MASS	J
101	8.30011E-04	2.13893E-01	4.14753E 07	9.90809E-01	2.54832E 02	1.85141E 10	0	2.24020E-03	101
102	8.54911E-04	2.11748E-01	3.98873E 07	9.52887E-01	2.55785E 02	1.72869E 10	0	2.30741E-03	102
103	8.80559E-04	2.12628E-01	3.83207E 07	9.15449E-01	2.56700E 02	1.61240E 10	0	2.37663E-03	103
104	9.06975E-04	2.13535E-01	3.67759E 07	8.78545E-01	2.57579E 02	1.50233E 10	0	2.44793E-03	104
105	9.34185E-04	2.14470E-01	3.52555E 07	8.42223E-01	2.58421E 02	1.39827E 10	0	2.52136E-03	105
106	9.62210E-04	2.15432E-01	3.37613E 07	8.06529E-01	2.59228E 02	1.30001E 10	0	2.59701E-03	106
107	9.91076E-04	2.16423E-01	3.22952E 07	7.71505E-01	2.59999E 02	1.20733E 10	0	2.67492E-03	107
108	1.02081E-03	2.17444E-01	3.08588E 07	7.37191E-01	2.60736E 02	1.12004E 10	0	2.75516E-03	108
109	1.05143E-03	2.18495E-01	2.94537E 07	7.03624E-01	2.61440E 02	1.03790E 10	0	2.83782E-03	109
110	1.08298E-03	2.19578E-01	2.80813E 07	6.70839E 01	2.62111E 02	9.60717E 09	0	2.92295E-03	110
111	1.11547E-03	2.20694E-01	2.67429E 07	6.38866E-01	2.62750E 02	8.88281E 09	0	3.01064E-03	111
112	1.14893E-03	2.21843E-01	2.54398E 07	6.07735E-01	2.63357E 02	8.20385E 09	0	3.10096E-03	112
113	1.18340E-03	2.23026E-01	2.41729E 07	5.77471E-01	2.63935E 02	7.56825E 09	0	3.19399E-03	113
114	1.21890E-03	2.24245E-01	2.29432E 07	5.48094E-01	2.64483E 02	6.97603E 09	0	3.28981E-03	114
115	1.25547E-03	2.25500E-01	2.17515E 07	5.19625E-01	2.65003E 02	6.41921E 09	0	3.38850E-03	115
116	1.29313E-03	2.26793E-01	2.05984E 07	4.92079E-01	2.65495E 02	5.90186E 09	0	3.49016E-03	116
117	1.33192E-03	2.28125E-01	1.94845E 07	4.65468E-01	2.65960E 02	5.42009E 09	0	3.59486E-03	117
118	1.37188E-03	2.29497E-01	1.84101E 07	4.39801E-01	2.66400E 02	4.97206E 09	0	3.70271E-03	118
119	1.41304E-03	2.30910E-01	1.73755E 07	4.15085E-01	2.66815E 02	4.55596E 09	0	3.81379E-03	119
120	1.45543E-03	2.32366E-01	1.63807E 07	3.91322E-01	2.67206E 02	4.17003E 09	0	3.92820E-03	120
121	1.49909E-03	2.33865E-01	1.54259E 07	3.68512E-01	2.67575E 02	3.81259E 09	0	4.04605E-03	121
122	1.54406E-03	2.35409E-01	1.45109E 07	3.46652E-01	2.67922E 02	3.48197E 09	0	4.16743E-03	122
123	1.59039E-03	2.36999E-01	1.36353E 07	3.25736E-01	2.68247E 02	3.17658E 09	0	4.29245E-03	123
124	1.63810E-03	2.38637E-01	1.27989E 07	3.05754E-01	2.68553E 02	2.89487E 09	0	4.42123E-03	124
125	1.68724E-03	2.40325E-01	1.20011E 07	2.86695E-01	2.68840E 02	2.63536E 09	0	4.55386E-03	125
126	1.73786E-03	2.42062E-01	1.12413E 07	2.68545E-01	2.69108E 02	2.39662E 09	0	4.69048E-03	126
127	1.78999E-03	2.43852E-01	1.05188E 07	2.51286E-01	2.69360E 02	2.17727E 09	0	4.83119E-03	127
128	1.84369E-03	2.45696E-01	9.83291E 06	2.34900E-01	2.69595E 02	1.97601E 09	0	4.97613E-03	128
129	1.89900E-03	2.47595E-01	9.18264E 06	2.19365E-01	2.69814E 02	1.79159E 09	0	5.12541E-03	129
130	1.95598E-03	2.49551E-01	8.56706E 06	2.04660E-01	2.70019E 02	1.62280E 09	0	5.27918E-03	130
131	2.01465E-03	2.51566E-01	7.98515E 06	1.90758E-01	2.70209E 02	1.46852E 09	0	5.43755E-03	131
132	2.07509E-03	2.53641E-01	7.43581E 06	1.77635E-01	2.70387E 02	1.32766E 09	0	5.60068E-03	132
133	2.13735E-03	2.55778E-01	6.91790E 06	1.65263E-01	2.70552E 02	1.19921E 09	0	5.76870E-03	133
134	2.20147E-03	2.57980E-01	6.43024E 06	1.53613E-01	2.70706E 02	1.08221E 09	0	5.94176E-03	134
135	2.26751E-03	2.60247E-01	5.97162E 06	1.42657E-01	2.70848E 02	9.75753E 08	0	6.12001E-03	135
136	2.33554E-03	2.62583E-01	5.54081E 06	1.32365E-01	2.70981E 02	8.78989E 08	0	6.30361E-03	136
137	2.40560E-03	2.64988E-01	5.13655E 06	1.22708E-01	2.71104E 02	7.91125E 08	0	6.49272E-03	137
138	2.47777E-03	2.67466E-01	4.75760E 06	1.13655E-01	2.71217E 02	7.11417E 08	0	6.68750E-03	138
139	2.55210E-03	2.70018E-01	4.40272E 06	1.05177E-01	2.71322E 02	6.39175E 08	0	6.88813E-03	139
140	2.62867E-03	2.72647E-01	4.07066E 06	9.72446E-02	2.71420E 02	5.73755E 08	0	7.09477E-03	140
141	2.70753E-03	2.75354E-01	3.76022E 06	8.98285E-02	2.71509E 02	5.14562E 08	0	7.30761E-03	141
142	2.78875E-03	2.78143E-01	3.47021E 06	8.29005E-02	2.71592E 02	4.61045E 08	0	7.52684E-03	142
143	2.87242E-03	2.81016E-01	3.19949E 06	7.64331E-02	2.71669E 02	4.12696E 08	0	7.75265E-03	143
144	2.95859E-03	2.83974E-01	2.94694E 06	7.03998E-02	2.71739E 02	3.69048E 08	0	7.98523E-03	144
145	3.04735E-03	2.87021E-01	2.71148E 06	6.47750E-02	2.71804E 02	3.29672E 08	0	8.22479E-03	145
146	3.13877E-03	2.90160E-01	2.49211E 06	5.95343E-02	2.71863E 02	2.94174E 08	0	8.47153E-03	146
147	3.23293E-03	2.93393E-01	2.28783E 06	5.46544E-02	2.71918E 02	2.62195E 08	0	8.72567E-03	147
148	3.32992E-03	2.96723E-01	2.09773E 06	5.01130E-02	2.71968E 02	2.33407E 08	0	8.98744E-03	148
149	3.42981E-03	3.00153E-01	1.92093E 06	4.58894E-02	2.72014E 02	2.07510E 08	0	9.25707E-03	149
150	3.53271E-03	3.03686E-01	1.75660E 06	4.19638E-02	2.72056E 02	1.84231E 08	0	9.53478E-03	150

*** TEST PROBLEM NO. 1 *** TWO MATERIAL *** ARBITRARY SPECTRUM

J	DX	X	ERGS	CAL	SUM CAL	ERGS/GM	VELOCITY	ZONE MASS	J
151	3.63869E-03	3.07324E-01	1.60398E 06	3.83177E-02	2.72094E 02	1.63324E 08	0	9.82082E-03	151
152	3.74785E-03	3.11072E-01	1.46233E 06	3.49337E-02	2.72129E 02	1.44564E 08	0	1.01154E-02	152
153	3.86029E-03	3.14932E-01	1.33096E 06	3.17956E-02	2.72161E 02	1.27745E 08	0	1.04189E-02	153
154	3.97609E-03	3.18909E-01	1.20926E 06	2.88882E-02	2.72190E 02	1.12683E 08	0	1.07315E-02	154
155	4.09538E-03	3.23004E-01	1.09662E 06	2.61973E-02	2.72216E 02	9.92107E 07	0	1.10534E-02	155
156	4.21824E-03	3.27222E-01	9.92481E 05	2.37095E-02	2.72240E 02	8.71743E 07	0	1.13850E-02	156
157	4.34479E-03	3.31567E-01	8.96331E 05	2.14126E-02	2.72261E 02	7.64358E 07	0	1.17266E-02	157
158	4.47513E-03	3.36042E-01	8.07679E 05	1.92948E-02	2.72281E 02	6.68698E 07	0	1.20784E-02	158
159	4.60938E-03	3.40651E-01	7.26068E 05	1.73451E-02	2.72298E 02	5.83622E 07	0	1.24407E-02	159
160	4.74766E-03	3.45399E-01	6.51069E 05	1.55535E-02	2.72314E 02	5.08094E 07	0	1.28139E-02	160
161	4.89009E-03	3.50289E-01	5.82275E 05	1.39100E-02	2.72327E 02	4.41172E 07	0	1.31986E-02	161
162	5.03680E-03	3.55326E-01	5.19302E 05	1.24057E-02	2.72340E 02	3.81999E 07	0	1.35943E-02	162
163	5.18790E-03	3.60514E-01	4.61787E 05	1.10317E-02	2.72351E 02	3.29797E 07	0	1.40021E-02	163
164	5.34354E-03	3.65857E-01	4.09382E 05	9.77979E-03	2.72361E 02	2.83855E 07	0	1.44222E-02	164
165	5.50384E-03	3.71361E-01	3.61758E 05	8.64208E-03	2.72369E 02	2.43526E 07	0	1.48549E-02	165
166	5.66896E-03	3.77030E-01	3.18597E 05	7.61102E-03	2.72377E 02	2.08226E 07	0	1.53005E-02	166
167	5.83903E-03	3.82869E-01	2.79598E 05	6.67936E-03	2.72384E 02	1.77415E 07	0	1.57595E-02	167
168	6.01420E-03	3.88883E-01	2.44470E 05	5.84019E-03	2.72389E 02	1.50607E 07	0	1.62323E-02	168
169	6.19463E-03	3.95078E-01	2.12935E 05	5.08684E-03	2.72395E 02	1.27359E 07	0	1.67193E-02	169
170	6.38046E-03	4.01459E-01	1.84725E 05	4.41292E-03	2.72399E 02	1.07268E 07	0	1.72209E-02	170
171	6.57188E-03	4.08030E-01	1.59584E 05	3.81231E-03	2.72403E 02	8.99696E 06	0	1.77375E-02	171
172	6.76903E-03	4.14799E-01	1.37265E 05	3.27914E-03	2.72406E 02	7.51329E 06	0	1.82696E-02	172
173	6.97211E-03	4.21772E-01	1.17534E 05	2.80779E-03	2.72409E 02	6.24593E 06	0	1.88177E-02	173
174	7.18127E-03	4.28953E-01	1.00166E 05	2.39289E-03	2.72411E 02	5.16795E 06	0	1.93822E-02	174
175	7.39671E-03	4.36350E-01	8.49483E 04	2.02934E-03	2.72413E 02	4.25514E 06	0	1.99637E-02	175
176	7.61861E-03	4.43968E-01	7.16768E 04	1.71230E-03	2.72415E 02	3.48578E 06	0	2.05626E-02	176
177	7.84717E-03	4.51815E-01	6.01603E 04	1.43718E-03	2.72416E 02	2.84050E 06	0	2.11795E-02	177
178	8.08258E-03	4.59898E-01	5.02185E 04	1.19968E-03	2.72418E 02	2.30203E 06	0	2.18149E-02	178
179	8.32506E-03	4.68223E-01	4.16821E 04	9.95750E-04	2.72419E 02	1.85507E 06	0	2.24693E-02	179
180	8.57481E-03	4.76798E-01	3.43937E 04	8.21637E-04	2.72419E 02	1.48611E 06	0	2.31434E-02	180
181	8.83205E-03	4.85630E-01	2.82071E 04	6.73845E-04	2.72420E 02	1.18330E 06	0	2.38377E-02	181
182	9.09702E-03	4.94727E-01	2.29876E 04	5.49155E-04	2.72421E 02	9.36252E 05	0	2.45528E-02	182
183	9.36993E-03	5.04097E-01	1.86118E 04	4.44621E-04	2.72421E 02	7.35952E 05	0	2.52894E-02	183
184	9.65102E-03	5.13748E-01	1.49673E 04	3.57555E-04	2.72421E 02	5.74600E 05	0	2.60481E-02	184
185	9.94056E-03	5.23688E-01	1.19523E 04	2.85531E-04	2.72422E 02	4.45491E 05	0	2.68296E-02	185
186	1.02388E-02	5.33927E-01	9.47581E 03	2.26369E-04	2.72422E 02	3.42899E 05	0	2.76344E-02	186
187	1.05459E-02	5.44473E-01	7.45634E 03	1.78126E-04	2.72422E 02	2.61962E 05	0	2.84635E-02	187
188	1.08623E-02	5.55335E-01	5.82199E 03	1.39082E-04	2.72422E 02	1.98585E 05	0	2.93174E-02	188
189	1.11882E-02	5.66524E-01	4.50963E 03	1.07731E-04	2.72422E 02	1.49341E 05	0	3.01969E-02	189
190	1.15238E-02	5.78047E-01	3.46433E 03	8.27599E-05	2.72422E 02	1.11383E 05	0	3.11028E-02	190
191	1.18695E-02	5.89917E-01	2.63869E 03	6.30361E-05	2.72423E 02	8.23667E 04	0	3.20359E-02	191
192	1.22256E-02	6.02143E-01	1.99218E 03	4.75914E-05	2.72423E 02	6.03745E 04	0	3.29970E-02	192
193	1.25924E-02	6.14735E-01	1.49043E 03	3.56052E-05	2.72423E 02	4.38532E 04	0	3.39869E-02	193
194	1.29702E-02	6.27705E-01	1.10463E 03	2.63886E-05	2.72423E 02	3.15550E 04	0	3.50065E-02	194
195	1.33593E-02	6.41064E-01	8.10759E 02	1.93691E-05	2.72423E 02	2.24865E 04	0	3.60567E-02	195
196	1.37601E-02	6.54824E-01	5.89189E 02	1.40752E-05	2.72423E 02	1.58647E 04	0	3.71384E-02	196
197	1.41729E-02	6.68997E-01	4.23759E 02	1.01232E-05	2.72423E 02	1.10779E 04	0	3.82525E-02	197
198	1.45980E-02	6.83595E-01	0	0	2.72423E 02	0	0	3.94001E-02	198
199	1.50360E-02	6.98631E-01	0	0	2.72423E 02	0	0	4.05821E-02	199
200	1.54871E-02	7.14118E-01	0	0	2.72423E 02	0	0	4.17996E-02	200

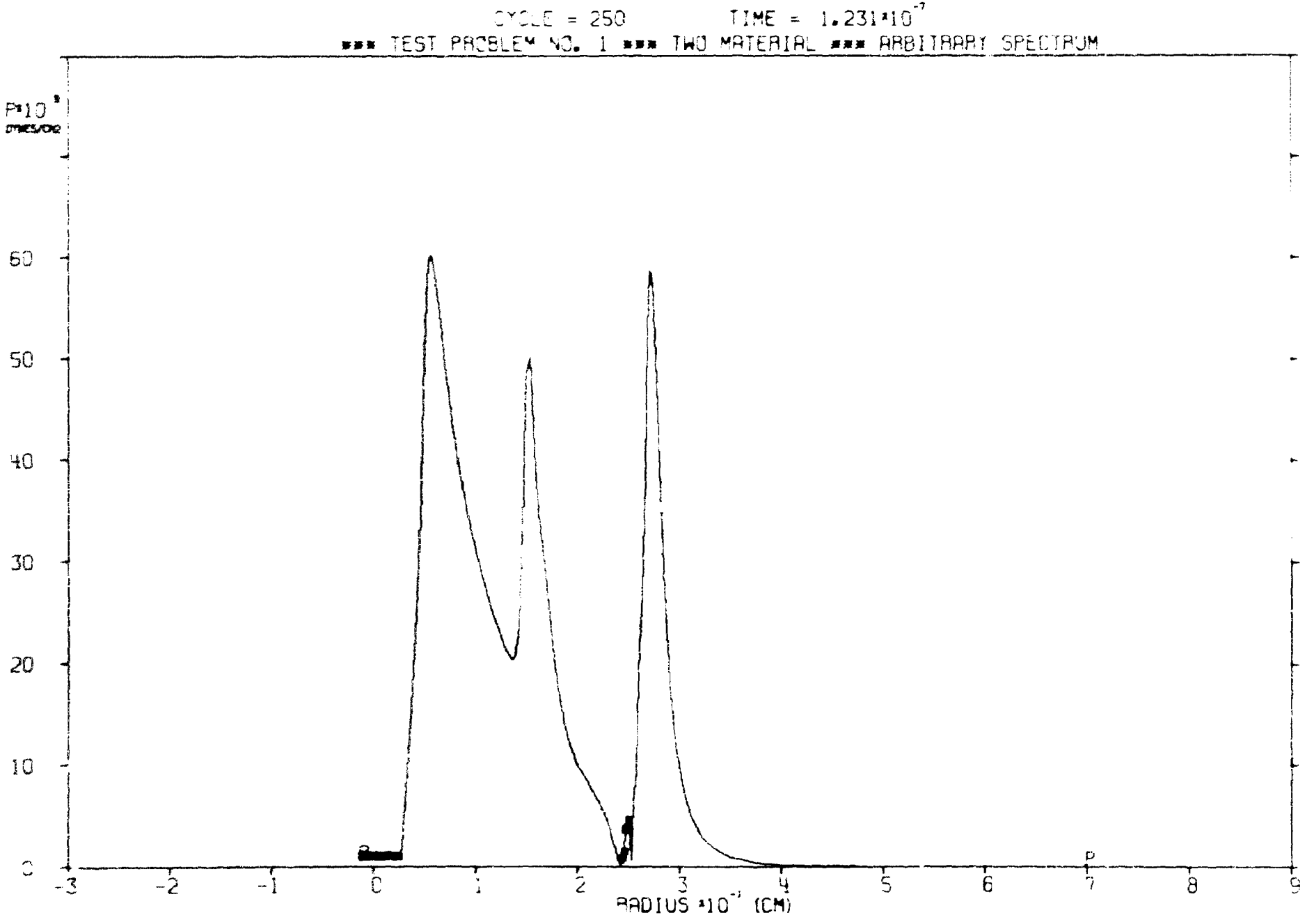
*** TEST PROBLEM NO. 1 *** TWO MATERIAL *** ARBITRARY SPECTRUM

J	DX	X	ERGS	CAL	SUM CAL	ERGS/GM	VELOCITY	ZONE MASS	J
201	1.59517E-02	7.30070E-01	0	0	2.72423E 02	0	0	4.30536E-02	201
202	1.64302E-02	7.46500E-01	0	0	2.72423E 02	0	0	4.43452E-02	202
203	1.69231E-02	7.63423E-01	0	0	2.72423E 02	0	0	4.56755E-02	203
204	1.74308E-02	7.80854E-01	0	0	2.72423E 02	0	0	4.70456E-02	204
205	1.79537E-02	7.98808E-01	0	0	2.72423E 02	0	0	4.84572E-02	205
206	1.84924E-02	8.17300E-01	0	0	2.72423E 02	0	0	4.99109E-02	206
207	1.90471E-02	8.36347E-01	0	0	2.72423E 02	0	0	5.14082E-02	207
208	1.96185E-02	8.55966E-01	0	0	2.72423E 02	0	0	5.29505E-02	208
209	2.02071E-02	8.76173E-01	0	0	2.72423E 02	0	0	5.45390E-02	209
210	2.08133E-02	8.96986E-01	0	0	2.72423E 02	0	0	5.61751E-02	210
211	2.14377E-02	9.18424E-01	0	0	2.72423E 02	0	0	5.78604E-02	211
212	2.20808E-02	9.40505E-01	0	0	2.72423E 02	0	0	5.95962E-02	212
213	2.27433E-02	9.63248E-01	0	0	2.72423E 02	0	0	6.13841E-02	213
214	2.34256E-02	9.86674E-01	0	0	2.72423E 02	0	0	6.32256E-02	214
215	2.41283E-02	1.01080E 00	0	0	2.72423E 02	0	0	6.51224E-02	215
216	2.48522E-02	1.03565E 00	0	0	2.72423E 02	0	0	6.70761E-02	216
217	2.55978E-02	1.06125E 00	0	0	2.72423E 02	0	0	6.90883E-02	217
218	2.63657E-02	1.08762E 00	0	0	2.72423E 02	0	0	7.11610E-02	218
219	2.71567E-02	1.11477E 00	0	0	2.72423E 02	0	0	7.32958E-02	219
220	2.79714E-02	1.14275E 00	0	0	2.72423E 02	0	0	7.54947E-02	220
221	2.88105E-02	1.17156E 00	0	0	2.72423E 02	0	0	7.77595E-02	221
222	2.96748E-02	1.20123E 00	0	0	2.72423E 02	0	0	8.00923E-02	222
223	3.05651E-02	1.23180E 00	0	0	2.72423E 02	0	0	8.24951E-02	223
224	3.14820E-02	1.26328E 00	0	0	2.72423E 02	0	0	8.49699E-02	224
225	3.24265E-02	1.29570E 00	0	0	2.72423E 02	0	0	8.75190E-02	225
226	3.33993E-02	1.32910E 00	0	0	2.72423E 02	0	0	9.01446E-02	226
227	3.44012E-02	1.36351E 00	0	0	2.72423E 02	0	0	9.28489E-02	227
228	3.54333E-02	1.39894E 00	0	0	2.72423E 02	0	0	9.56344E-02	228
229	3.64963E-02	1.43543E 00	0	0	2.72423E 02	0	0	9.85034E-02	229
230	3.75912E-02	1.47303E 00	0	0	2.72423E 02	0	0	1.01459E-01	230
231	3.87189E-02	1.51174E 00	0	0	2.72423E 02	0	0	1.04503E-01	231
232	3.98805E-02	1.55163E 00	0	0	2.72423E 02	0	0	1.07637E-01	232
233	4.10769E-02	1.59270E 00	0	0	2.72423E 02	0	0	1.10866E-01	233
234	4.23092E-02	1.63501E 00	0	0	2.72423E 02	0	0	1.14192E-01	234
235	4.35785E-02	1.67859E 00	0	0	2.72423E 02	0	0	1.17618E-01	235
236	4.48858E-02	1.72348E 00	0	0	2.72423E 02	0	0	1.21147E-01	236
237	4.62324E-02	1.76971E 00	0	0	2.72423E 02	0	0	1.24781E-01	237
238	4.76194E-02	1.81733E 00	0	0	2.72423E 02	0	0	1.28525E-01	238
239	4.90479E-02	1.86639E 00	0	0	2.72423E 02	0	0	1.32380E-01	239
240	5.05194E-02	1.91689E 00	0	0	2.72423E 02	0	0	1.36352E-01	240
241	5.20350E-02	1.96893E 00	0	0	2.72423E 02	0	0	1.40442E-01	241
242	5.35960E-02	2.02253E 00	0	0	2.72423E 02	0	0	1.44656E-01	242
243	5.52039E-02	2.07773E 00	0	0	2.72423E 02	0	0	1.48995E-01	243
244	5.68600E-02	2.13459E 00	0	0	2.72423E 02	0	0	1.53465E-01	244
245	5.85658E-02	2.19316E 00	0	0	2.72423E 02	0	0	1.58069E-01	245
246	6.03228E-02	2.25348E 00	0	0	2.72423E 02	0	0	1.62811E-01	246
247	6.21325E-02	2.31561E 00	0	0	2.72423E 02	0	0	1.67696E-01	247
248	6.39964E-02	2.37961E 00	0	0	2.72423E 02	0	0	1.72726E-01	248
249	6.59163E-02	2.44552E 00	0	0	2.72423E 02	0	0	1.77908E-01	249
250	6.78938E-02	2.51342E 00	0	0	2.72423E 02	0	0	1.83245E-01	250

*** TEST PROBLEM NO. 1 *** TWO MATERIAL *** ARBITRARY SPECTRUM

J	DX	X	ERGS	CAL	SUM CAL	ERGS/GM	VELOCITY	ZONE MASS	J
251	6.99306E-02	2.58335E 00	0	0	2.72423E 02	0	0	1.88743E-01	251
252	7.20286E-02	2.65538E 00	0	0	2.72423E 02	0	0	1.94405E-01	252
253	7.41894E-02	2.72957E 00	0	0	2.72423E 02	0	0	2.00237E-01	253
254	7.64151E-02	2.80598E 00	0	0	2.72423E 02	0	0	2.06244E-01	254
255	7.87075E-02	2.88469E 00	0	0	2.72423E 02	0	0	2.12432E-01	255
256	8.10688E-02	2.96576E 00	0	0	2.72423E 02	0	0	2.18805E-01	256
257	8.35008E-02	3.04926E 00	0	0	2.72423E 02	0	0	2.25369E-01	257
258	8.60059E-02	3.13526E 00	0	0	2.72423E 02	0	0	2.32130E-01	258
259	8.85860E-02	3.22385E 00	0	0	2.72423E 02	0	0	2.39094E-01	259
260	9.12436E-02	3.31509E 00	0	0	2.72423E 02	0	0	2.46267E-01	260
261	9.39809E-02	3.40907E 00	0	0	2.72423E 02	0	0	2.53655E-01	261
262	9.68004E-02	3.50587E 00	0	0	2.72423E 02	0	0	2.61264E-01	262
263	9.97044E-02	3.60558E 00	0	0	2.72423E 02	0	0	2.69102E-01	263
264	1.02695E-01	3.70827E 00	0	0	2.72423E 02	0	0	2.77175E-01	264
265	1.05776E-01	3.81405E 00	0	0	2.72423E 02	0	0	2.85490E-01	265
266	1.08950E-01	3.92300E 00	0	0	2.72423E 02	0	0	2.94055E-01	266
267	1.12218E-01	4.03522E 00	0	0	2.72423E 02	0	0	3.02877E-01	267
268	1.15585E-01	4.15080E 00	0	0	2.72423E 02	0	0	3.11963E-01	268
269	1.19052E-01	4.26986E 00	0	0	2.72423E 02	0	0	3.21322E-01	269
270	1.22624E-01	4.39248E 00	0	0	2.72423E 02	0	0	3.30962E-01	270
271	1.26303E-01	4.51878E 00	0	0	2.72423E 02	0	0	3.40890E-01	271
272	1.30092E-01	4.64887E 00	0	0	2.72423E 02	0	0	3.51117E-01	272
273	1.33994E-01	4.78287E 00	0	0	2.72423E 02	0	0	3.61651E-01	273
274	1.38014E-01	4.92088E 00	0	0	2.72423E 02	0	0	3.72500E-01	274
275	1.42155E-01	5.06304E 00	0	0	2.72423E 02	0	0	3.83675E-01	275
276	1.46419E-01	5.20946E 00	0	0	2.72423E 02	0	0	3.95185E-01	276
277	1.50812E-01	5.36027E 00	0	0	2.72423E 02	0	0	4.07041E-01	277
278	1.55336E-01	5.51560E 00	0	0	2.72423E 02	0	0	4.19252E-01	278
279	1.59996E-01	5.67560E 00	0	0	2.72423E 02	0	0	4.31830E-01	279
280	1.64796E-01	5.84040E 00	0	0	2.72423E 02	0	0	4.44785E-01	280
281	1.69740E-01	6.01014E 00	0	0	2.72423E 02	0	0	4.58128E-01	281
282	1.74832E-01	6.18497E 00	0	0	2.72423E 02	0	0	4.71872E-01	282

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
25	4.7198E-10	7.9497E-11	175	83	4.5949E 09	1.9913E-01	-7.0702E-01	7.3859E-01	3.1565E-02
6.8695E-12	-1.5387E-10	4.2858E 00	-1.2048E 00	1.2023E 00	-5.9711E-08	1.9865E-01	0	6.1850E 00	282
CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
50	7.1041E-09	3.0000E-10	186	89	5.0340E 10	2.0240E-01	4.3799E 01	1.3928E 02	1.8307E 02
3.6585E-09	8.7527E-10	6.4493E 01	-2.6028E 02	2.6027E 02	-1.2190E-04	1.9859E-01	0	6.1850E 00	282
CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
75	1.4604E-08	3.0000E-10	188	96	7.4505E 10	2.0706E-01	1.9282E 02	4.0224E 02	5.9507E 02
7.9869E-09	2.5881E-09	1.3258E 02	-9.1505E 02	9.1504E 02	-5.1313E-04	1.9838E-01	0	6.1850E 00	282
CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
100	2.2104E-08	3.0000E-10	190	101	8.6487E 10	2.1109E-01	3.8071E 02	6.9457E 02	1.0753E 03
1.2433E-08	4.4019E-09	2.0067E 02	-1.7711E 03	1.7711E 03	-1.1739E-03	1.9808E-01	0	6.1850E 00	282
CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
125	2.9604E-08	3.0000E-10	191	106	9.2405E 10	2.1576E-01	6.5675E 02	9.1635E 02	1.5731E 03
1.7024E-08	7.1073E-09	2.6876E 02	-2.7531E 03	2.7530E 03	-2.1088E-03	1.9775E-01	0	6.1850E 00	282
CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
150	4.7895E-08	7.2876E-10	195	19	8.0638E 10	2.1764E-02	3.5406E 02	2.3624E 03	2.7165E 03
3.3688E-08	4.3908E-09	2.7149E 02	-4.6566E 03	4.6565E 03	-4.9237E-03	1.9716E-01	0	6.1850E 00	282
CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
175	6.8827E-08	9.2583E-10	197	25	7.2557E 10	3.1174E-02	5.9193E 02	3.3689E 03	3.9608E 03
5.4589E-08	8.1581E-09	2.7150E 02	-5.8770E 03	5.8770E 03	-7.8300E-03	1.9688E-01	0	6.1850E 00	282
CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
200	8.8289E-08	7.7466E-10	197	30	6.7043E 10	3.9970E-02	8.1549E 02	4.0846E 03	4.9001E 03
7.3089E-08	1.2164E-08	2.7151E 02	-6.5541E 03	6.5541E 03	-1.0496E-02	1.9681E-01	0	6.1850E 00	282
CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
225	1.0582E-07	6.4538E-10	198	34	6.3193E 10	4.7695E-02	1.0076E 03	4.6040E 03	5.6116E 03
8.8901E-08	1.5945E-08	2.7152E 02	-7.0274E 03	7.0274E 03	-1.2773E-02	1.9682E-01	0	6.1850E 00	282
CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
250	1.2309E-07	6.3603E-10	198	38	6.0194E 10	5.5995E-02	1.2518E 03	4.9579E 03	6.2097E 03
1.0316E-07	2.0797E-08	2.7153E 02	-7.4190E 03	7.4190E 03	-1.4978E-02	1.9686E-01	0	6.1850E 00	282


CYCLE = 250 TIME = 1.231*10^-7
*** TEST PROBLEM NO. 1 *** TWO MATERIAL *** ARBITRARY SPECTRUM
P*10^8
DYNES/CM2
60
50
40
30
20
10
0
-3
-2
-1
0
1
2
3
4
5
6
7
8
9
RADIUS *10^-1 (CM)

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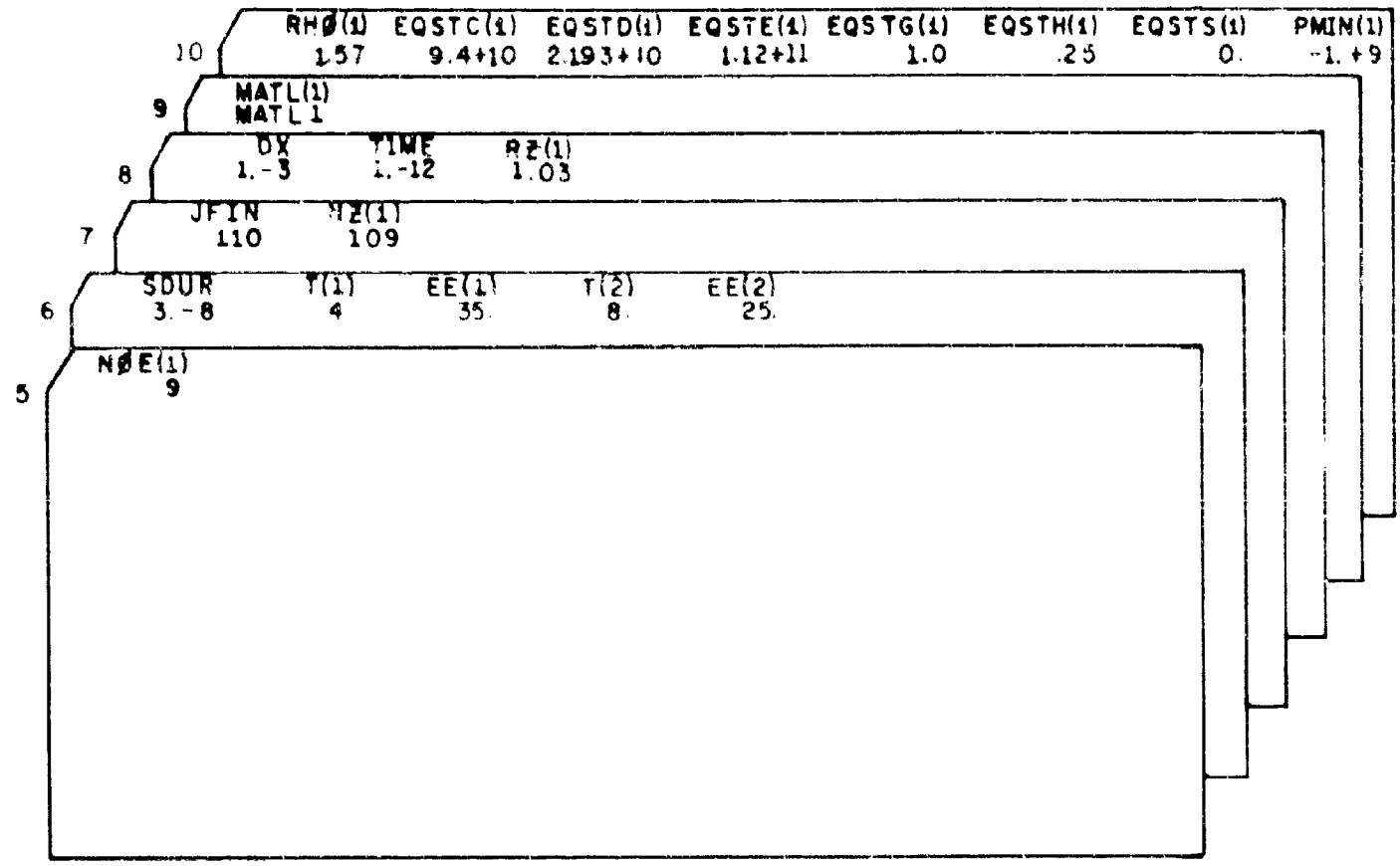
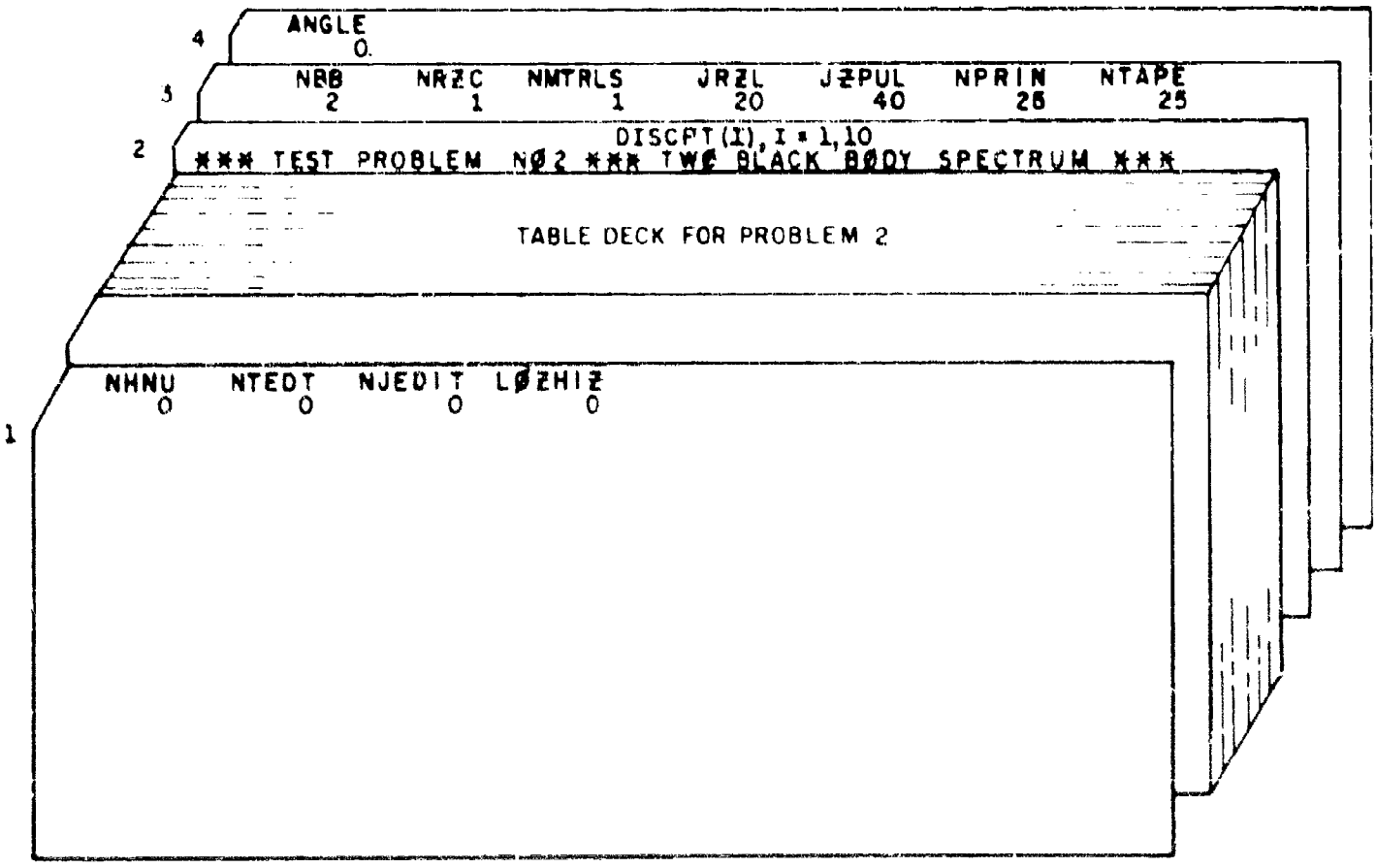
APPENDIX IV

TEST PROBLEM 2

(PUFF)


10
RHØ(1) EQSTC(1) EQSTD(1) EQSTE(1) EQSTG(1) EQSTH(1) EQSTS(1) PMIN(1)
1.57 9.4+10 2.193+10 1.12+11 1.0 .25 0. -1.+9
9
MATL(1)
MATL 1
8
DX TIME RZ(1)
1.-3 1.-12 1.03
7
JFIN NZ(1)
110 109
6
SOUR T(1) EE(1) T(2) EE(2)
3.-8 4 35. 8. 25.
5
NØE(1)
9


4
ANGLE
0.
3
NRB NRZC NMTRLS JRZL JZPUL NPRIN NTAPE
2 1 1 20 40 25 25
2
DISCPT(I), I = 1,10
*** TEST PROBLEM NØ2 *** TWØ BLACK BØDY SPECTRUM ***
TABLE DECK FOR PROBLEM 2
1
NHNU NTEDT NJEDIT LØZHIZ
0 0 0 0

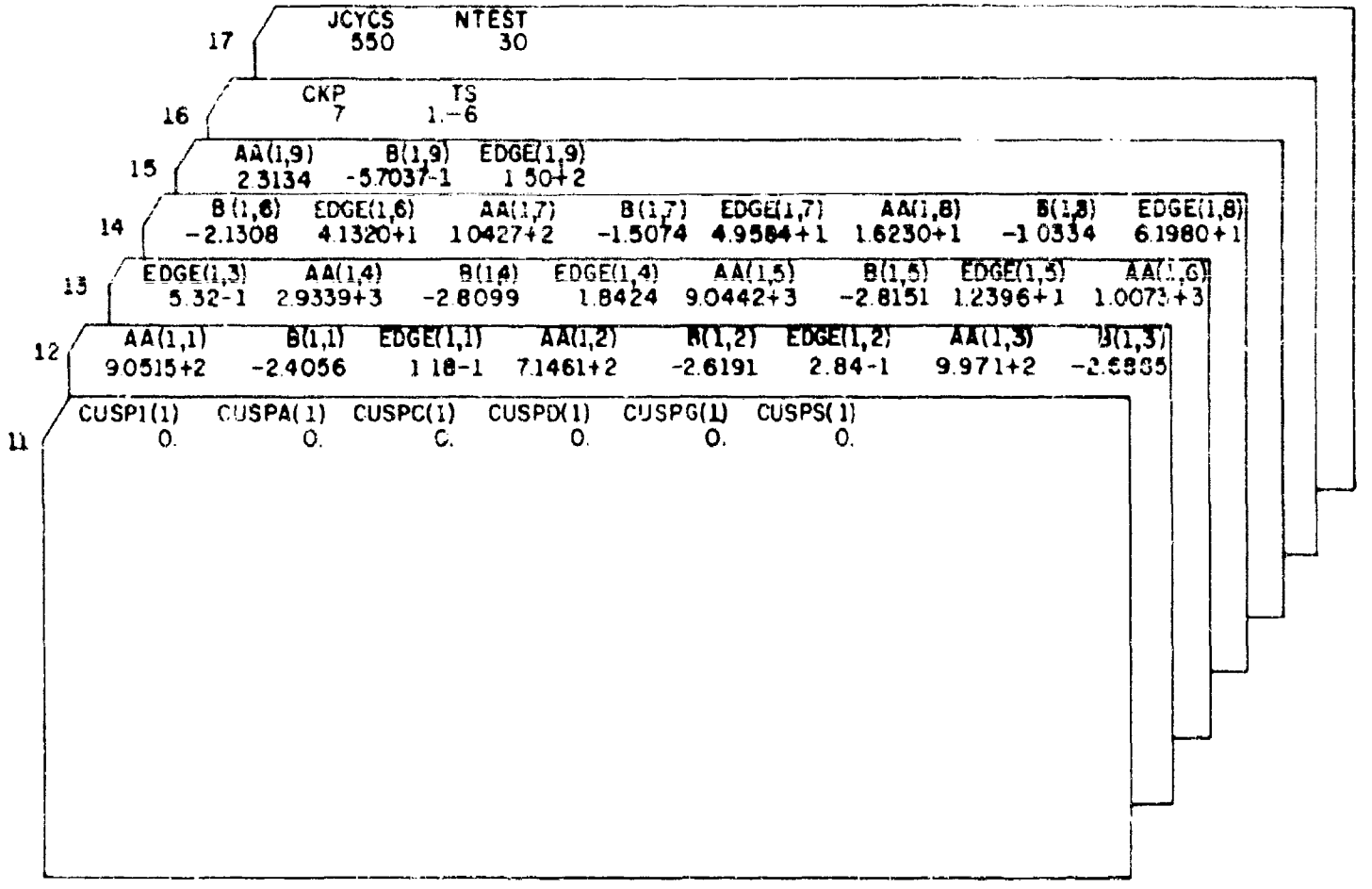

17
JCYCS
550
NTEST
30
16
CKP
7
TS
1.-6
15
AA(1,9)
2.3134
B(1,9)
-5.7037-1
EDGE(1,9)
1.50+2
14
B(1,6)
-2.1308
EDGE(1,6)
4.1320+1
AA(1,7)
1.0427+2
B(1,7)
-1.5074
EDGE(1,7)
4.9584+1
AA(1,8)
1.6230+1
B(1,8)
-1.0334
EDGE(1,8)
6.1980+1
13
EDGE(1,3)
5.32-1
AA(1,4)
2.9339+3
B(1,4)
-2.8099
EDGE(1,4)
1.8424
AA(1,5)
9.0442+3
B(1,5)
-2.8151
EDGE(1,5)
1.2396+1
12
AA(1,1)
9.0515+2
B(1,1)
-2.4056
EDGE(1,1)
1.18-1
AA(1,2)
7.1461+2
B(1,2)
-2.6191
EDGE(1,2)
2.84-1
AA(1,3)
9.971+2
11
CUSP1(1)
0.
CUSPA(1)
0.
CUSPC(1)
0.
CUSPD(1)
0.
CUSPG(1)
0.
CUSPS(1)
0.

TABLE DECK FOR TEST PROBLEM 2

FORMAT 8E10.3

.828	.812	.946	1.06	1.15	1.24	1.32	1.40	TBL CARD 1
1.47	1.53	1.60	1.66	1.72	1.78	1.83	1.89	TBL CARD 2
1.94	1.99	2.05	2.10	2.15	2.20	2.24	2.29	TBL CARD 3
2.34	2.39	2.43	2.48	2.53	2.57	2.62	2.67	TBL CARD 4
2.71	2.76	2.80	2.85	2.89	2.94	2.99	3.03	TBL CARD 5
3.08	3.12	3.17	3.22	3.26	3.31	3.36	3.41	TBL CARD 6
3.45	3.50	3.55	3.60	3.65	3.70	3.75	3.80	TBL CARD 7
3.86	3.91	3.96	4.02	4.07	4.13	4.18	4.24	TBL CARD 8
4.30	4.36	4.42	4.48	4.55	4.61	4.68	4.75	TBL CARD 9
4.82	4.89	4.97	5.04	5.12	5.20	5.29	5.38	TBL CARD 10
5.47	5.56	5.66	5.77	5.88	6.00	6.12	6.26	TBL CARD 11
6.40	6.55	6.72	6.91	7.12	7.36	7.63	7.97	TBL CARD 12
8.39	8.97	9.94	10.1	10.2	10.4	10.6	10.8	TBL CARD 13
11.2	11.6	12.1	13.3	15.0				

```
INPUT PARAMETERS FOR - -


** TEST PROBLEM NO. 2 *** TWO BLACK BODY SPECTRUM ***
***** THIS PROBLEM WAS RUN ON PUFF/1604 *****
TABLE VALUES
6.287E-01 8.118E-01 9.464E-01 1.058E 00 1.155E 00 1.242E 00 1.322E 00 1.397E 00 1.468E 00 1.535E 00

1.599E 00 1.660E 00 1.720E 00 1.777E 00 1.833E 00 1.888E 00 1.942E 00 1.994E 00 2.046E 00 2.096E 00

2.146E 00 2.196E 00 2.244E 00 2.292E 00 2.340E 00 2.388E 00 2.435E 00 2.481E 00 2.528E 00 2.574E 00

2.620E 00 2.666E 00 2.712E 00 2.757E 00 2.803E 00 2.849E 00 2.895E 00 2.940E 00 2.986E 00 3.032E 00

3.078E 00 3.124E 00 3.171E 00 3.217E 00 3.264E 00 3.311E 00 3.359E 00 3.406E 00 3.454E 00 3.503E 00

3.552E 00 3.601E 00 3.651E 00 3.701E 00 3.752E 00 3.804E 00 3.856E 00 3.908E 00 3.962E 00 4.016E 00

4.071E 00 4.127E 00 4.184E 00 4.242E 00 4.300E 00 4.360E 00 4.421E 00 4.484E 00 4.548E 00 4.613E 00

4.680E 00 4.748E 00 4.818E 00 4.891E 00 4.965E 00 5.042E 00 5.121E 00 5.203E 00 5.288E 00 5.376E 00

5.468E 00 5.563E 00 5.664E 00 5.769E 00 5.880E 00 5.997E 00 6.122E 00 6.255E 00 6.398E 00 6.553E 00

6.723E 00 6.909E 00 7.119E 00 7.357E 00 7.634E 00 7.968E 00 8.390E 00 8.972E 00 9.942E 00 1.009E 01

1.025E 01 1.043E 01 1.064E 01 1.088E 01 1.118E 01 1.157E 01 1.210E 01 1.303E 01 1.500E 01

      NBB       NRZC     NMTRLS       JRZL      JZPUL      NPRIN      ANGLE
        2          1          1         20         40         25 1.000E 00

EITOT =              0

LOZHIZ =          0


ZONING CONSTANTS


   RATIO 1.030E 00 TO ZONE   109


BLACK BODY TEMPERATURE AND ASSOCIATED ENERGY
TEMPERATURE       ENERGY
 4.000E 00        3.500E 01
 8.000E 00        2.500E 01

     JFIN      JCYCS      NTEST      NTAPE        CKP         TS       TIME       SOUR
      110        550         30         25 7.000E-01 1.000E-06 1.000E-12 3.000E-08
```

MATERIAL PROPERTIES FOR MATL 1 RHO= 1.570E 00 FROM J= 1 TO J= 110
MATERIAL THICKNESS = 8.025E-01

EQSTC	EQSTD	EQSTE	EQSTG	EQSTH	EQSTS	EQSTN	PMIN
9.40000E 10	2.19300E 10	1.12000E 11	1.00000E 00	2.50000E-01	0	5.34577E-01	-1.00000E 09

NDE= 9	AA	B	EDGE
	9.05150E 02	-2.40560E 00	1.18000E-01
	7.14610E 02	-2.61910E 00	2.84000E-01
	9.97100E 02	-2.68850E 00	5.32000E-01
	2.93390E 03	-2.80990E 00	1.84240E 00
	9.04420E 03	-2.81510E 00	1.23960E 01
	1.00730E 03	-2.13040E 00	4.13200E 01
	1.04270E 02	-1.50740E 00	4.95840E 01
	1.62300E 01	-1.03340E 00	6.19800E 01
	2.31340E 00	-5.70370E-01	1.50000E 02

*** TEST PROBLEM NO. 2 *** TWO BLACK BODY SPECTRUM ***

J	DX	X	ERGS	CAL	SUM CAL	ERGS/GM	VELOCITY	ZONE MASS	J
2	1.00000E-03	1.00000E-03	5.57191E 07	1.33108E 00	1.33108E 00	3.54898E 10	0	1.57000E-03	2
3	1.03000E-03	2.03000E-03	4.41541E 07	1.05480E 00	2.38589E 00	2.73045E 10	0	1.61710E-03	3
4	1.06090E-03	3.09090E-03	3.78997E 07	9.05391E-01	3.29128E 00	2.27542E 10	0	1.66561E-03	4
5	1.09273E-03	4.18363E-03	3.40457E 07	8.13322E-01	4.10460E 00	1.98450E 10	0	1.71558E-03	5
6	1.12551E-03	5.30914E-03	3.13833E 07	7.49721E-01	4.85432E 00	1.77603E 10	0	1.76705E-03	6
7	1.15927E-03	6.46841E-03	2.93868E 07	7.02025E-01	5.55635E 00	1.61460E 10	0	1.82006E-03	7
8	1.19405E-03	7.66246E-03	2.78075E 07	6.64299E-01	6.22064E 00	1.48334E 10	0	1.87466E-03	8
9	1.22987E-03	8.89234E-03	2.65148E 07	6.33416E-01	6.85406E 00	1.37318E 10	0	1.93090E-03	9
10	1.26677E-03	1.01591E-02	2.54314E 07	6.07534E-01	7.46159E 00	1.27871E 10	0	1.98883E-03	10
11	1.30477E-03	1.14639E-02	2.45076E 07	5.85466E-01	8.04706E 00	1.19637E 10	0	2.04849E-03	11
12	1.34392E-03	1.28078E-02	2.37093E 07	5.66396E-01	8.61346E 00	1.12369E 10	0	2.10995E-03	12
13	1.38423E-03	1.41920E-02	2.30120E 07	5.49737E-01	9.16319E 00	1.05888E 10	0	2.17325E-03	13
14	1.42576E-03	1.56178E-02	2.23973E 07	5.35054E-01	9.69825E 00	1.00058E 10	0	2.23844E-03	14
15	1.46853E-03	1.70863E-02	2.18516E 07	5.22015E-01	1.02203E 01	9.47761E 09	0	2.30560E-03	15
16	1.51259E-03	1.85989E-02	2.13639E 07	5.10365E-01	1.07306E 01	8.99620E 09	0	2.37477E-03	16
17	1.55797E-03	2.01569E-02	2.09257E 07	4.99898E-01	1.12305E 01	8.55504E 09	0	2.44601E-03	17
18	1.60471E-03	2.17616E-02	2.05302 07	4.90450E-01	1.17210E 01	8.14889E 09	0	2.51939E-03	18
19	1.65285E-03	2.34144E-02	2.01718E 07	4.81887E-01	1.22029E 01	7.77341E 09	0	2.59497E-03	19
20	1.70243E-03	2.51169E-02	1.98457E 07	4.74098E-01	1.26770E 01	7.42502E 09	0	2.67282E-03	20
21	1.75351E-03	2.68704E-02	1.95482E 07	4.66991E-01	1.31439E 01	7.10069E 09	0	2.75300E-03	21
22	1.80611E-03	2.86765E-02	1.92760E 07	4.60487E-01	1.36044E 01	6.79786E 09	0	2.83559E-03	22
23	1.86029E-03	3.05368E-02	1.90262E 07	4.54520E-01	1.40590E 01	6.51435E 09	0	2.92066E-03	23
24	1.91610E-03	3.24529E-02	1.87966E 07	4.49035E-01	1.45080E 01	6.24828E 09	0	3.00828E-03	24
25	1.97359E-03	3.44265E-02	1.85851E 07	4.43983E-01	1.49520E 01	5.99804E 09	0	3.09853E-03	25
26	2.03279E-03	3.64593E-02	1.83900E 07	4.39322E-01	1.53913E 01	5.76220E 09	0	3.19149E-03	26
27	2.09378E-03	3.85530E-02	1.82098E 07	4.35016E-01	1.58263E 01	5.53955E 09	0	3.28723E-03	27
28	2.15659E-03	4.07096E-02	1.80431E 07	4.31035E-01	1.62573E 01	5.32898E 09	0	3.38585E-03	28
29	2.22129E-03	4.29309E-02	1.78889E 07	4.27351E-01	1.66847E 01	5.12955E 09	0	3.48742E-03	29
30	2.28793E-03	4.52189E-02	1.77462E 07	4.23941E-01	1.71086E 01	4.94041E 09	0	3.59205E-03	30
31	2.35657E-03	4.75754E-02	1.76140E 07	4.20784E-01	1.75294E 01	4.76080E 09	0	3.69981E-03	31
32	2.42726E-03	5.00027E-02	1.74917E 07	4.17862E-01	1.79473E 01	4.59004E 09	0	3.81080E-03	32
33	2.50008E-03	5.25028E-02	1.73786E 07	4.15160E-01	1.83624E 01	4.42752E 09	0	3.92513E-03	33
34	2.57508E-03	5.50778E-02	1.72740E 07	4.12661E-01	1.87751E 01	4.27270E 09	0	4.04289E-03	34
35	2.65234E-03	5.77302E-02	1.71775E 07	4.10355E-01	1.91855E 01	4.12507E 09	0	4.16417E-03	35
36	2.73191E-03	6.04621E-02	1.70885E 07	4.08230E-01	1.95937E 01	3.98418E 09	0	4.28909E-03	36
37	2.81386E-03	6.32759E-02	1.70067E 07	4.06276E-01	2.00000E 01	3.84962E 09	0	4.41776E-03	37
38	2.89828E-03	6.61742E-02	1.69317E 07	4.04483E-01	2.04045E 01	3.72100E 09	0	4.55030E-03	38
39	2.98523E-03	6.91594E-02	1.68630E 07	4.02844E-01	2.08073E 01	3.59798E 09	0	4.68681E-03	39
40	3.07478E-03	7.22342E-02	1.68005E 07	4.01350E-01	2.12086E 01	3.48023E 09	0	4.82741E-03	40
41	3.16703E-03	7.54013E-02	1.67438E 07	3.99995E-01	2.16086E 01	3.36746E 09	0	4.97224E-03	41
42	3.26204E-03	7.86633E-02	1.66926E 07	3.98772E-01	2.20074E 01	3.25938E 09	0	5.12140E-03	42
43	3.35990E-03	8.20232E-02	1.66467E 07	3.97675E-01	2.24051E 01	3.15574E 09	0	5.27504E-03	43
44	3.46070E-03	8.54839E-02	1.66058E 07	3.96698E-01	2.28018E 01	3.05630E 09	0	5.43329E-03	44
45	3.56452E-03	8.90484E-02	1.65697E 07	3.95836E-01	2.31976E 01	2.96083E 09	0	5.59629E-03	45
46	3.67145E-03	9.27199E-02	1.65382E 07	3.95083E-01	2.35927E 01	2.86913E 09	0	5.76418E-03	46
47	3.78160E-03	9.65015E-02	1.65110E 07	3.94435E-01	2.39871E 01	2.78099E 09	0	5.93711E-03	47
48	3.89504E-03	1.00397E-01	1.64881E 07	3.93886E-01	2.43810E 01	2.69623E 09	0	6.11522E-03	48
49	4.01190E-03	1.04408E-01	1.64690E 07	3.93431E-01	2.47745E 01	2.61468E 09	0	6.29868E-03	49
50	4.13225E-03	1.08541E-01	1.64538E 07	3.93067E-01	2.51675E 01	2.53617E 09	0	6.48764E-03	50

*** TEST PROBLEM NO. 2 *** TWO BLACK BODY SPECTRUM ***

J	DX	X	ERGS	CAL	SUM CAL	ERGS/GM	VELOCITY	ZONE MASS	J
51	4.25622E-03	1.12797E-01	1.64420E 07	3.92784E-01	2.55603E 01	2.46055E 09	0	6.68226E-03	51
52	4.38391E-03	1.17181E-01	1.64336E 07	3.92586E-01	2.59529E 01	2.38766E 09	0	6.88273E-03	52
53	4.51542E-03	1.21596E-01	1.64284E 07	3.92460E-01	2.63454E 01	2.31738E 09	0	7.08921E-03	53
54	4.65089E-03	1.26047E-01	1.64260E 07	3.92404E-01	2.67378E 01	2.24956E 09	0	7.30189E-03	54
55	4.79041E-03	1.30537E-01	1.64264E 07	3.92412E-01	2.71302E 01	2.18408E 09	0	7.52095E-03	55
56	4.93412E-03	1.35072E-01	1.64292E 07	3.92480E-01	2.75227E 01	2.12083E 09	0	7.74658E-03	56
57	5.08215E-03	1.39654E-01	1.64343E 07	3.92601E-01	2.79153E 01	2.05970E 09	0	7.97897E-03	57
58	5.23461E-03	1.44288E-01	1.64413E 07	3.92770E-01	2.83080E 01	2.00057E 09	0	8.21834E-03	58
59	5.39165E-03	1.48978E-01	1.64502E 07	3.92980E-01	2.87010E 01	1.94334E 09	0	8.46489E-03	59
60	5.55340E-03	1.53733E-01	1.64605E 07	3.93227E-01	2.90942E 01	1.88792E 09	0	8.71884E-03	60
61	5.72000E-03	1.58553E-01	1.64720E 07	3.93503E-01	2.94877E 01	1.83422E 09	0	8.98040E-03	61
62	5.89160E-03	1.63445E-01	1.64846E 07	3.93802E-01	2.98815E 01	1.78215E 09	0	9.24982E-03	62
63	6.06835E-03	1.68413E-01	1.64978E 07	3.94118E-01	3.02757E 01	1.73163E 09	0	9.52731E-03	63
64	6.25040E-03	1.73461E-01	1.65114E 07	3.94444E-01	3.06701E 01	1.68258E 09	0	9.81313E-03	64
65	6.43791E-03	1.78702E-01	1.65251E 07	3.94772E-01	3.10649E 01	1.63493E 09	0	1.01075E-02	65
66	6.63105E-03	1.84333E-01	1.65387E 07	3.95095E-01	3.14600E 01	1.58861E 09	0	1.04108E-02	66
67	6.82998E-03	2.01163E-01	1.65517E 07	3.95406E-01	3.18554E 01	1.54356E 09	0	1.07231E-02	67
68	7.03488E-03	2.08198E-01	1.65639E 07	3.95698E-01	3.22511E 01	1.49971E 09	0	1.10448E-02	68
69	7.24593E-03	2.15444E-01	1.65750E 07	3.95963E-01	3.26470E 01	1.45700E 09	0	1.13761E-02	69
70	7.46331E-03	2.22907E-01	1.65847E 07	3.96193E-01	3.30432E 01	1.41539E 09	0	1.17174E-02	70
71	7.68721E-03	2.30594E-01	1.65925E 07	3.96381E-01	3.34396E 01	1.37481E 09	0	1.20689E-02	71
72	7.91782E-03	2.38512E-01	1.65983E 07	3.96519E-01	3.38361E 01	1.33524E 09	0	1.24310E-02	72
73	8.15536E-03	2.46667E-01	1.66017E 07	3.96600E-01	3.42327E 01	1.29661E 09	0	1.28039E-02	73
74	8.40002E-03	2.55067E-01	1.66023E 07	3.96615E-01	3.46293E 01	1.25889E 09	0	1.31880E-02	74
75	8.65202E-03	2.63719E-01	1.65999E 07	3.96557E-01	3.50259E 01	1.22205E 09	0	1.35837E-02	75
76	8.91158E-03	2.72631E-01	1.65941E 07	3.96420E-01	3.54223E 01	1.18604E 09	0	1.39912E-02	76
77	9.17893E-03	2.81810E-01	1.65847E 07	3.96195E-01	3.58185E 01	1.15085E 09	0	1.44109E-02	77
78	9.45429E-03	2.91264E-01	1.65714E 07	3.95877E-01	3.62144E 01	1.11643E 09	0	1.48432E-02	78
79	9.73792E-03	3.01002E-01	1.65539E 07	3.95458E-01	3.66098E 01	1.08276E 09	0	1.52885E-02	79
80	1.00301E-02	3.11032E-01	1.65319E 07	3.94932E-01	3.70048E 01	1.04983E 09	0	1.57472E-02	80
81	1.03310E-02	3.21363E-01	1.65052E 07	3.94294E-01	3.73991E 01	1.01760E 09	0	1.62196E-02	81
82	1.06409E-02	3.32004E-01	1.64735E 07	3.93538E-01	3.77926E 01	9.86072E 08	0	1.67062E-02	82
83	1.09601E-02	3.42964E-01	1.64367E 07	3.92659E-01	3.81853E 01	9.55213E 08	0	1.72074E-02	83
84	1.12889E-02	3.54253E-01	1.63946E 07	3.91653E-01	3.85769E 01	9.25014E 08	0	1.77236E-02	84
85	1.16276E-02	3.65881E-01	1.63470E 07	3.90515E-01	3.89674E 01	8.95463E 08	0	1.82553E-02	85
86	1.19764E-02	3.77857E-01	1.62937E 07	3.89242E-01	3.93567E 01	8.66549E 08	0	1.88030E-02	86
87	1.23357E-02	3.90193E-01	1.62347E 07	3.87832E-01	3.97445E 01	8.38262E 08	0	1.93671E-02	87
88	1.27058E-02	4.02898E-01	1.61698E 07	3.86282E-01	4.01308E 01	8.10594E 08	0	1.99481E-02	88
89	1.30870E-02	4.15985E-01	1.60990E 07	3.84591E-01	4.05154E 01	7.83538E 08	0	2.05465E-02	89
90	1.34796E-02	4.29465E-01	1.60222E 07	3.82757E-01	4.08981E 01	7.57089E 08	0	2.11629E-02	90
91	1.38839E-02	4.43349E-01	1.59395E 07	3.80780E-01	4.12789E 01	7.31242E 08	0	2.17978E-02	91
92	1.43005E-02	4.57649E-01	1.58508E 07	3.78661E-01	4.16576E 01	7.05992E 08	0	2.24517E-02	92
93	1.47295E-02	4.72379E-01	1.57561E 07	3.76400E-01	4.20340E 01	6.81336E 08	0	2.31253E-02	93
94	1.51714E-02	4.87550E-01	1.56556E 07	3.73998E-01	4.24080E 01	6.57271E 08	0	2.38190E-02	94
95	1.56265E-02	5.03177E-01	1.55492E 07	3.71458E-01	4.27794E 01	6.33793E 08	0	2.45336E-02	95
96	1.60953E-02	5.19272E-01	1.54372E 07	3.68782E-01	4.31482E 01	6.10900E 08	0	2.52696E-02	96
97	1.65782E-02	5.35850E-01	1.53196E 07	3.65973E-01	4.35142E 01	5.88588E 08	0	2.60277E-02	97
98	1.70755E-02	5.52926E-01	1.51966E 07	3.63034E-01	4.38772E 01	5.66856E 08	0	2.68085E-02	98
99	1.75878E-02	5.70513E-01	1.50683E 07	3.59969E-01	4.42372E 01	5.45700E 08	0	2.76128E-02	99
100	1.81154E-02	5.88629E-01	1.49350E 07	3.56783E-01	4.45940E 01	5.25117E 08	0	2.84412E-02	100

*** TEST PROBLEM NO. 2 *** TWO BLACK BODY SPECTRUM ***

J	DX	X	ERGS	CAL	SUM CAL	ERGS/GM	VELOCITY	ZONE MASS	J
101	1.86589E-02	6.07288E-01	1.47967E 07	3.53451E-01	4.49475E 01	5.05103E 08	0	2.92944E-02	101
102	1.92186E-02	6.26506E-01	1.46538E 07	3.50066E-01	4.52975E 01	4.85654E 08	0	3.01733E-02	102
103	1.97952E-02	6.46302E-01	1.45063E 07	3.46544E-01	4.56441E 01	4.66765E 08	0	3.10784E-02	103
104	2.03890E-02	6.66691E-01	1.43547E 07	3.42921E-01	4.59870E 01	4.48432E 08	0	3.20108E-02	104
105	2.10007E-02	6.87691E-01	1.41990E 07	3.39202E-01	4.63262E 01	4.30649E 08	0	3.29711E-02	105
106	2.16307E-02	7.09322E-01	1.40395E 07	3.35392E-01	4.66616E 01	4.13410E 08	0	3.39603E-02	106
107	2.22797E-02	7.31602E-01	1.38765E 07	3.31497E-01	4.69931E 01	3.96707E 08	0	3.49791E-02	107
108	2.29481E-02	7.54550E-01	1.37101E 07	3.27522E-01	4.73206E 01	3.80535E 08	0	3.60284E-02	108
109	2.36365E-02	7.78186E-01	1.35406E 07	3.23473E-01	4.76441E 01	3.64884E 08	0	3.71093E-02	109
110	2.43456E-02	8.02532E-01	1.33683E 07	3.19356E-01	4.79634E 01	3.49748E 08	0	3.82226E-02	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
25	4.7198E-10	7.9497E-11	100	2	8.7225E 08	1.0000E-03	-8.6107E-02	8.1221E-02	-4.8853E-03
-5.6009E-12	-9.8718E-11	7.0714E-01	-1.5238E-01	1.4749E-01	-4.0932E-08	0	0	8.0253E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
50	7.1041E-09	3.0000E-10	109	3	8.8265E 09	2.0375E-03	4.2791E 00	2.0560E 01	2.4839E 01
2.8142E-09	4.8480E-10	1.1354E 01	-3.1435E 01	3.1430E 01	-9.8675E-05	0	0	8.0253E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
75	1.4604E-08	3.0000E-10	109	5	1.4918E 10	4.2177E-03	3.7882E 01	7.6222E 01	1.1410E 02
7.6489E-09	2.5394E-09	2.3344E 01	-1.1286E 02	1.1285E 02	-3.9257E-04	0	0	8.0253E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
100	2.2104E-08	3.0000E-10	109	7	1.9476E 10	6.5430E-03	7.1662E 01	1.5437E 02	2.2603E 02
1.1606E-08	3.6794E-09	3.5333E 01	-2.2049E 02	2.2049E 02	-8.0308E-04	0	0	8.0253E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
125	2.9604E-08	3.0000E-10	109	9	2.3100E 10	9.0175E-03	1.0779E 02	2.4748E 02	3.5527E 02
1.5380E-08	4.6664E-09	4.7323E 01	-3.5421E 02	3.5420E 02	-1.3023E-03	0	0	8.0254E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
150	7.6735E-08	2.3019E-09	109	19	1.7129E 10	2.3932E-02	2.8285E 02	6.6286E 02	9.4572E 02
5.5212E-08	1.6513E-08	4.7806E 01	-9.3875E 02	9.3875E 02	-4.0210E-03	0	0	8.0258E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
175	1.4503E-07	3.2275E-09	109	29	1.4295E 10	4.3950E-02	4.2203E 02	1.0018E 03	1.4239E 03
9.9604E-08	2.9522E-08	4.7809E 01	-1.4188E 03	1.4188E 03	-7.0607E-03	0	0	8.0272E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
200	2.1357E-07	2.6840E-09	109	37	1.2745E 10	6.4627E-02	5.4678E 02	1.2019E 03	1.7487E 03
1.3721E-07	4.2902E-08	4.7809E 01	-1.7455E 03	1.7455E 03	-9.4889E-03	0	0	8.0285E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
225	2.8084E-07	2.6931E-09	109	43	1.1775E 10	8.3684E-02	6.3273E 02	1.3615E 03	1.9942E 03
1.6935E-07	5.3733E-08	4.7809E 01	-1.9913E 03	1.9913E 03	-1.1493E-02	0	0	8.0294E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.9875E-07	6.4040E-08	4.7809E 01	-2.1919E 03	2.1919E 03	-1.3114E-02	0	0	8.0303E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
275	4.1437E-07	2.9713E-09	109	52	1.0380E 10	1.1943E-01	7.4716E 02	1.6227E 03	2.3699E 03
2.2831E-07	7.1978E-08	4.7809E 01	-2.3625E 03	2.3625E 03	-1.4611E-02	0	0	8.3314E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
300	4.8169E-07	2.7669E-09	109	56	9.9014E 09	1.3850E-01	8.2052E 02	1.7004E 03	2.5209E 03
2.5460E-07	8.2870E-08	4.7809E 01	-2.5153E 03	2.5153E 03	-1.5869E-02	0	0	8.3326E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
325	5.5191E-07	2.6651E-09	109	60	9.4463E 09	1.5984E-01	9.2123E 02	1.7387E 03	2.6597E 03
2.8155E-07	9.7496E-08	4.7809E 01	-2.6554E 03	2.6554E 03	-1.7073E-02	0	0	8.3339E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
350	6.1926E-07	2.6823E-09	109	63	9.0781E 09	1.7773E-01	9.6300E 02	1.8134E 03	2.7764E 03
3.0583E-07	1.0608E-07	4.7809E 01	-2.7763E 03	2.7763E 03	-1.8012E-02	0	0	8.3350E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
375	6.8803E-07	2.6368E-09	109	66	8.7178E 09	1.9718E-01	1.0306E 03	1.8586E 03	2.8892E 03
3.3142E-07	1.1822E-07	4.7808E 01	-2.8870E 03	2.8870E 03	-1.8967E-02	0	0	8.3363E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
400	7.5661E-07	2.8794E-09	109	69	8.3002E 09	2.1831E-01	1.1275E 03	1.8681E 03	2.9956E 03
3.6091E-07	1.3584E-07	4.7808E 01	-2.9819E 03	2.9819E 03	-1.9742E-02	0	0	8.3376E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
425	8.2528E-07	2.7194E-09	109	71	8.1350E 09	2.3379E-01	1.2206E 03	1.9626E 03	3.0834E 03
3.7902E-07	1.3777E-07	4.7808E 01	-3.0796E 03	3.0796E 03	-2.0504E-02	0	0	8.3390E-01	110

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
442	8.7133E-07	2.8330E-09	109	73	7.8481E 09	2.4977E-01	1.2110E 03	1.9343E 03	3.1453E 03
4.0077E-07	1.5430E-07	4.7808E 01	-3.1326E 03	3.1326E 03	-2.0889E-02	0	0	8.3399E-01	110
8.713E-07	442	-13	122						
8.713E-07	442	32	90						

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
442	8.7133E-07	2.8330E-09	90	41	7.8481E 09	2.4977E-01	9.4474E 02	2.1774E 03	3.1221E 03
3.9782E-07	1.2038E-07	4.7793E 01	-3.0958E 03	3.0926E 03	-2.0889E-02	0	0	8.3399E-01	91

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
445	8.7983E-07	2.7230E-09	90	41	7.9026E 09	2.4991E-01	8.9102E 02	2.2288E 03	3.1198E 03
3.9479E-07	1.1275E-07	4.7793E 01	-3.1135E 03	3.1 02E 03	-2.0974E-02	0	0	8.3401E-01	91

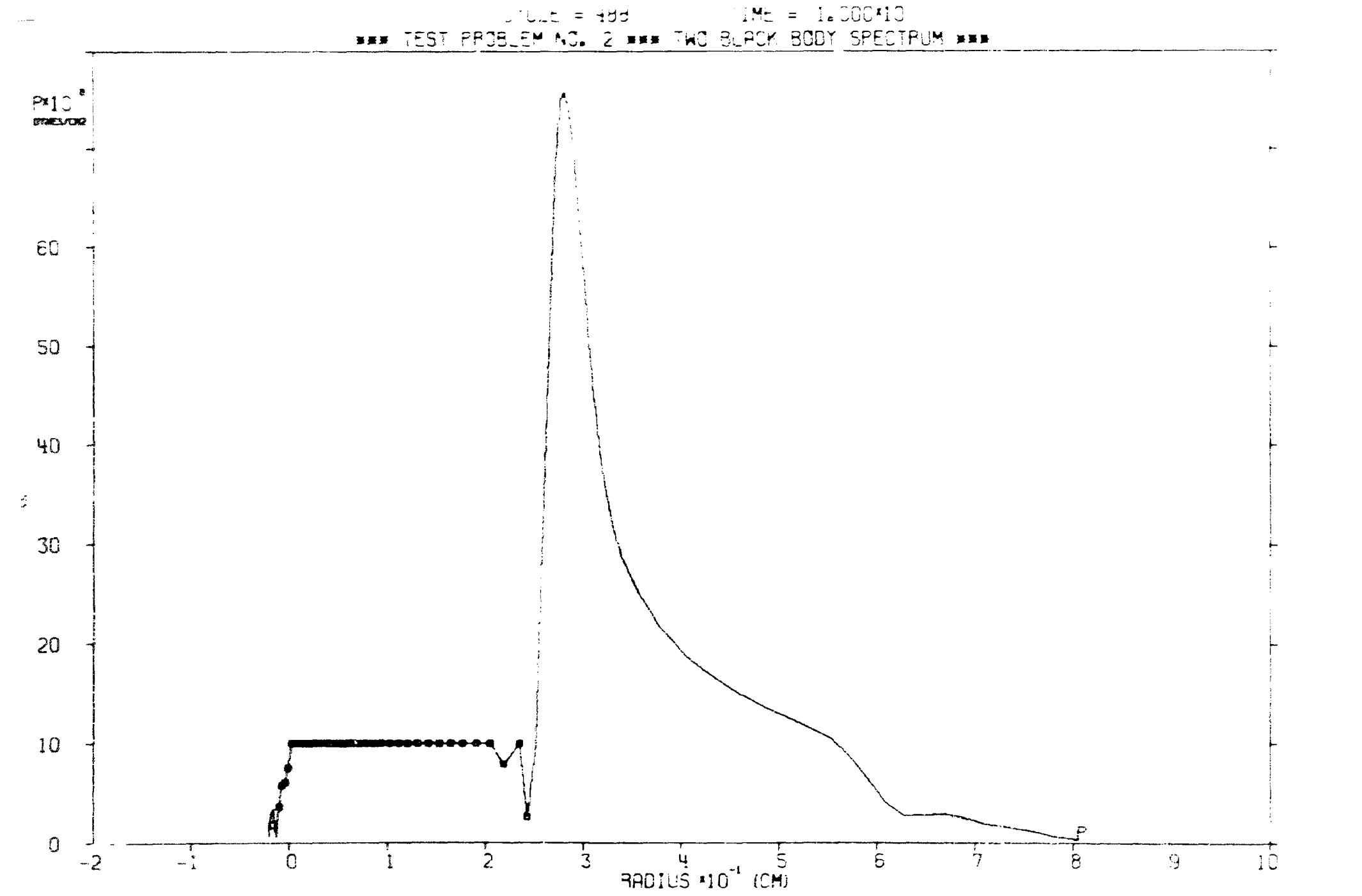
8.798E-07 445 -12 102

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
445	8.7983E-07	2.7230E-09	102	41	7.9026E 09	2.4991E-01	8.9102E 02	2.2288E 03	3.1198E 03
3.9479E-07	1.1275E-07	4.7794E 01	-3.1135E 03	3.1132E 03	-2.0974E-02	0	0	8.0401E-01	103

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
450	8.9318E-07	2.6519E-09	102	41	7.7934E 09	2.5013E-01	8.3561E 02	2.3142E 03	3.1498E 03
4.0416E-07	1.0722E-07	4.7794E 01	-3.1327E 03	3.1294E 03	-2.1078E-02	0	0	8.0404E-01	103

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
475	9.6413E-07	2.7656E-09	102	46	7.6499E 09	2.7166E-01	9.3657E 02	2.2970E 03	3.2335E 03
4.2269E-07	1.2243E-07	4.7801E 01	-3.2279E 03	3.2246E 03	-2.1727E-02	0	0	8.0419E-01	103

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
488	1.0002E-06	3.0228E-09	102	49	7.5793E 09	2.8081E-01	9.4767E 02	2.3251E 03	3.2728E 03
4.3181E-07	1.2503E-07	4.7804E 01	-3.2664E 03	3.2631E 03	-2.2017E-02	0	0	8.0427E-01	103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*** TEST PROBLEM NO. 2 *** TWO BLACK BODY SPECTRUM ***
P*10
60
50
40
30
20
10
0
-2
-1
0
1
2
3
4
5
6
7
8
9
10
RADIUS *10 (CM)
A
B
P

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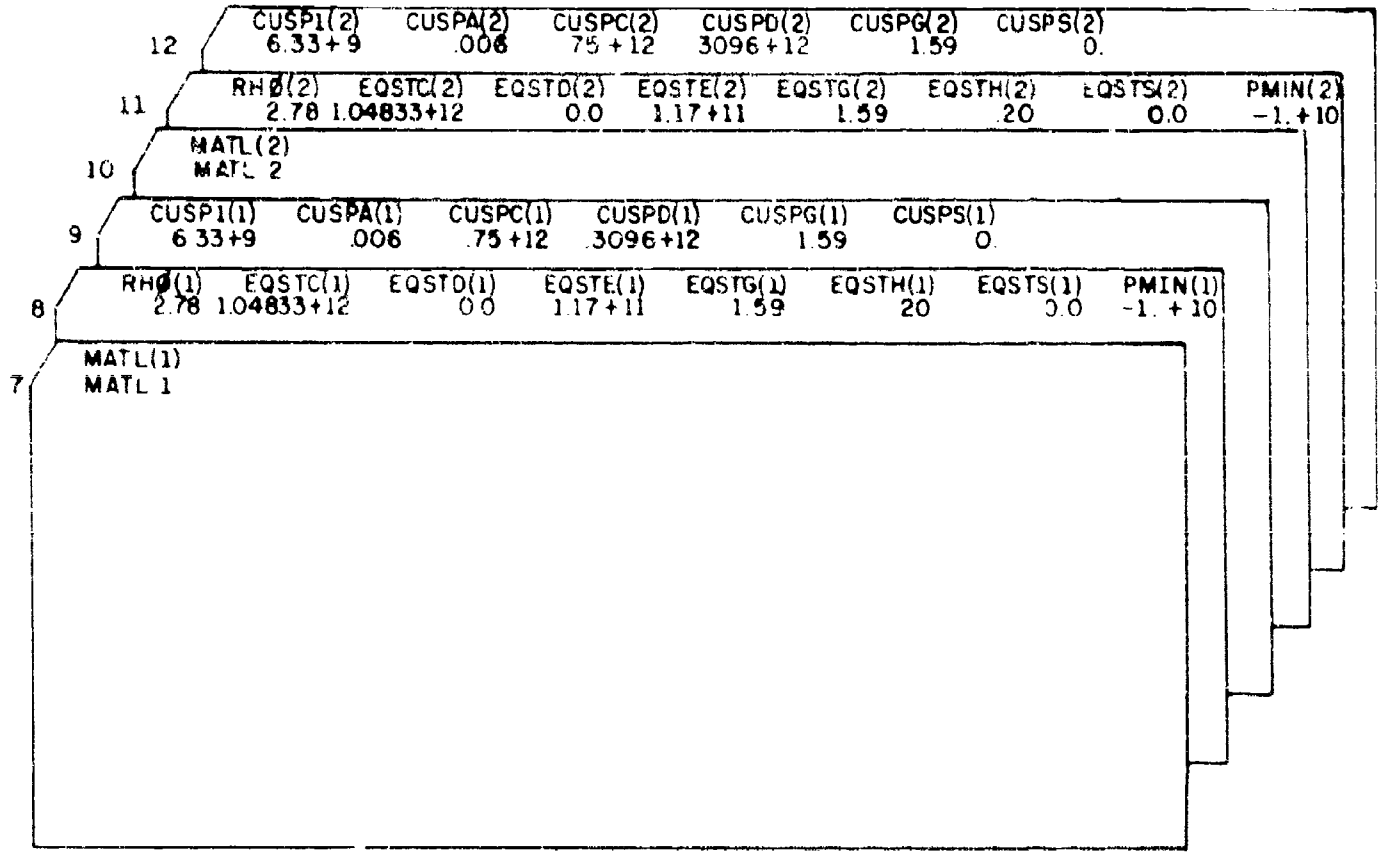
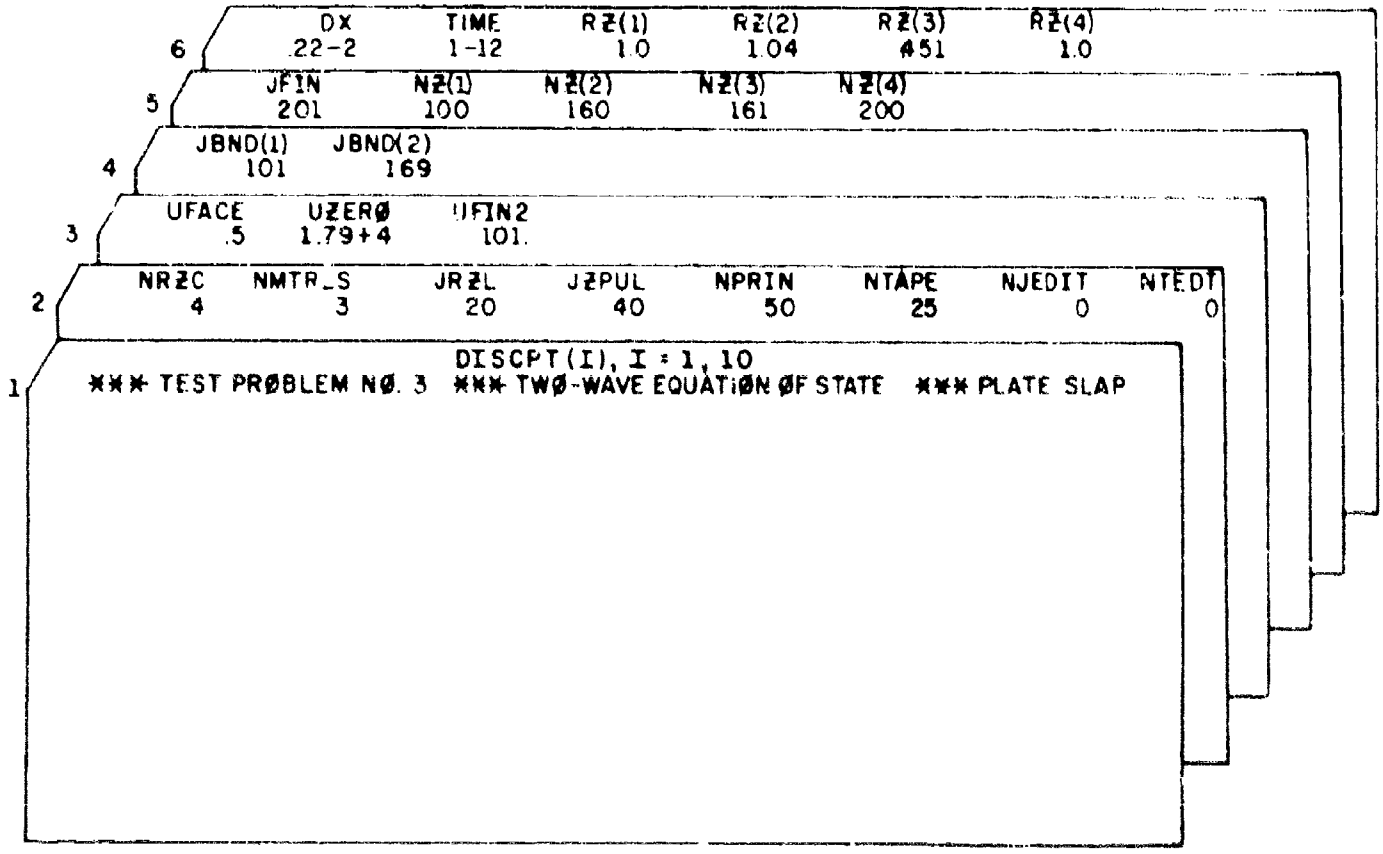
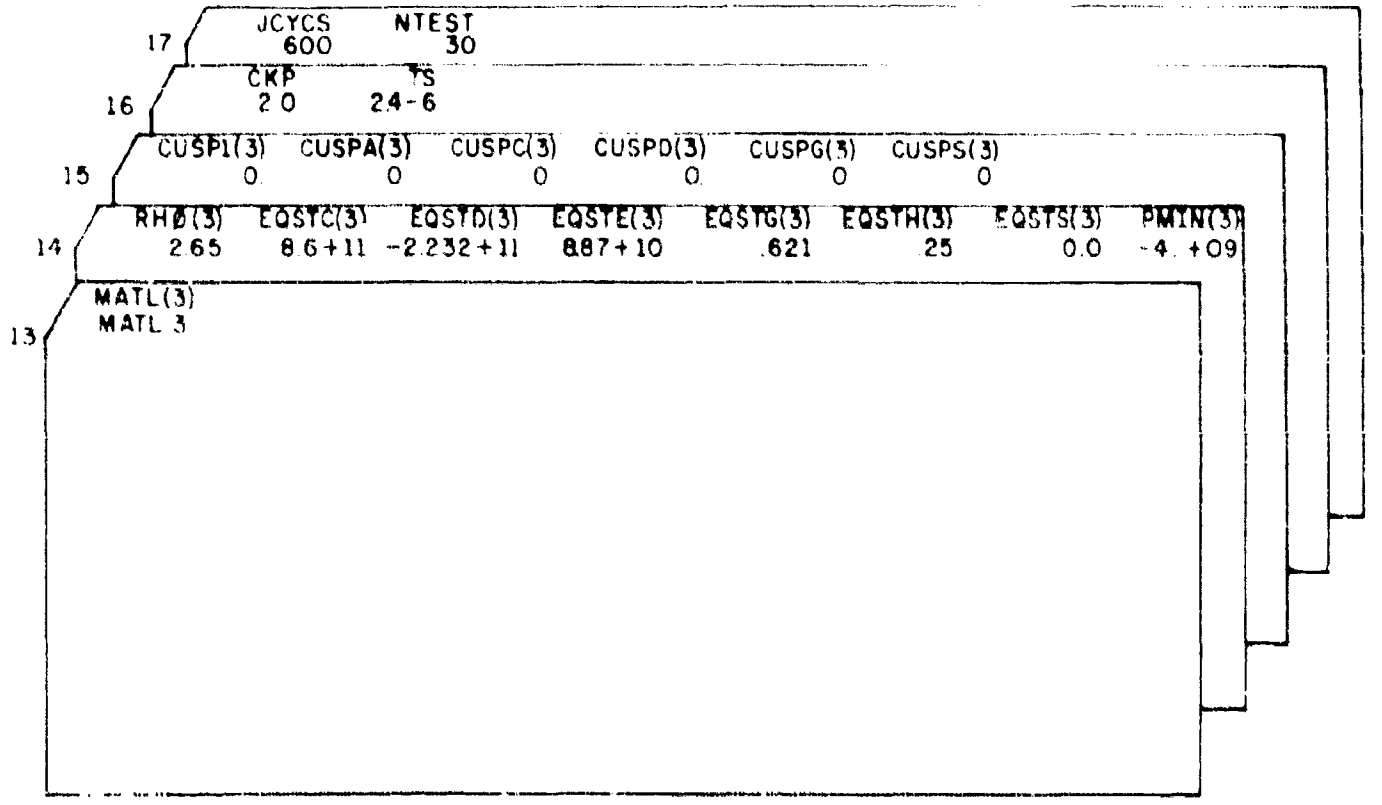
APPENDIX V

TEST PROBLEM 3

(P PUFF)


12
CUSP1(2) CUSPA(2) CUSPC(2) CUSPD(2) CUSPG(2) CUSPS(2)
6.33+9 .006 75+12 3096+12 1.59 0.
11
RHØ(2) EQSTC(2) EQSTO(2) EQSTE(2) EQSTG(2) EQSTH(2) EQSTS(2) PMIN(2)
2.78 1.04833+12 0.0 1.17+11 1.59 .20 0.0 -1.+10
10
MATL(2)
MATL 2
9
CUSP1(1) CUSPA(1) CUSPC(1) CUSPD(1) CUSPG(1) CUSPS(1)
6.33+9 .006 .75+12 .3096+12 1.59 0.
8
RHØ(1) EQSTC(1) EQSTO(1) EQSTE(1) EQSTG(1) EQSTH(1) EQSTS(1) PMIN(1)
2.78 1.04833+12 0.0 1.17+11 1.59 20 0.0 -1.+10
7
MATL(1)
MATL 1


6
DX TIME RZ(1) RZ(2) RZ(3) RZ(4)
.22-2 1-12 1.0 1.04 451 1.0
5
JFIN NZ(1) NZ(2) NZ(3) NZ(4)
201 100 160 161 200
4
JBND(1) JBND(2)
101 169
3
UFACE UZERØ UFIN2
.5 1.79+4 101.
2
NRZC NMTR_S JRZL JZPUL NPRIN NTAPE NJEDIT NTEDT
4 3 20 40 50 25 0 0
1
DISCPT(I), I = 1, 10
*** TEST PRØBLEM NØ. 3 *** TWØ-WAVE EQUATiØN ØF STATE *** PLATE SLAP


17
JCYCS
600
NTEST
30
16
CKP
2.0
TS
24-6
15
CUSPI(3)
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CUSPA(3)
0
CUSPC(3)
0
CUSPD(3)
0
CUSPG(3)
0
CUSPS(3)
0
14
RHØ(3)
2.65
EQSTC(3)
8.6+11
EQSTD(3)
-2.232+11
EQSTE(3)
887+10
EQSTG(3)
.621
EQSTH(3)
.25
EQSTS(3)
0.0
PMIN(3)
-4. +09
13
MATL(3)
MATL 3

INPUT PARAMETERS FOR - -

** TEST PROBLEM NO. 3 *** TWO-WAVE EQUATION OF STATE *** PLATE SLAP
**** THIS PROBLEM WAS RUN ON P-PUFF/1604 ****

NRZC	NMTRLS	JRZL	JZPUL	NPRIN	UFACE	UZERO	JFIN2
4	3	20	40	50	5.000E-01	1.790E 04	101

ZONING CONSTANTS

RATIO 1.000E 00 TO ZONE 100
RATIO 1.040E 00 TO ZONE 160
RATIO 4.510E-01 TO ZONE 161
RATIO 1.000E 00 TO ZONE 200

JFIN	JCYCS	NTEST	NTAPE	C<P	TS	TIME
201	600	30	25	2.000E 00	2.400E-06	1.000E-12

MATERIAL PROPERTIES FOR MATL 1 RHO= 2.780E 00 FROM J= 1 TO J= 101
MATERIAL THICKNESS = 2.200E-01

EQSTC	EQSTD	EQSTE	EQSTG	EQSTH	EQSTS	EQSTN	PMIN
1.04833E 12	0	1.17000E 11	1.59000E 00	2.00000E-01	0	2.02704E 00	-1.00000E 10

CUSP1	CUSPA	CUSPC	CUSPD	CUSPG	CUSPS
6.33000E 09	6.00000E-03	7.50000E 11	3.09600E 11	1.59000E 00	0

MATERIAL PROPERTIES FOR MATL 2 RHO= 2.780E 00 FROM J= 101 TO J= 169
MATERIAL THICKNESS = 6.280E-01

EQSTC	EQSTD	EQSTE	EQSTG	EQSTH	EQSTS	EQSTN	PMIN
1.04833E 12	0	1.17000E 11	1.59000E 00	2.00000E-01	0	2.02704E 00	-1.00000E 10

CUSP1	CUSPA	CUSPC	CUSPD	CUSPG	CUSPS
6.33000E 09	6.00000E-03	7.50000E 11	3.09600E 11	1.59000E 00	0

MATERIAL PROPERTIES FOR MATL 3 RHO= 2.650E 00 FROM J= 169 TO J= 201
MATERIAL THICKNESS = 3.340E-01

EQSTC	EQSTD	EQSTE	EQSTG	EQSTH	EQSTS	EQSTN	PMIN
8.60000E 11	-2.23200E 11	8.87000E 10	6.21000E-01	2.50000E-01	0	5.89166E 00	-4.00000E 09

*** TEST PROBLEM NO. 3 *** TWO-WAVE EQUATION OF STATE *** PLATE SLAP

J	X	VELOCITY	ZONE MASS
1	0	1.79000E 04	0
2	2.20000E-03	1.79000E 04	6.11600E-03
3	4.40000E-03	1.79000E 04	6.11600E-03
4	6.60000E-03	1.79000E 04	6.11600E-03
5	8.80000E-03	1.79000E 04	6.11600E-03
6	1.10000E-02	1.79000E 04	6.11600E-03
7	1.32000E-02	1.79000E 04	6.11600E-03
8	1.54000E-02	1.79000E 04	6.11600E-03
9	1.76000E-02	1.79000E 04	6.11600E-03
10	1.98000E-02	1.79000E 04	6.11600E-03
11	2.20000E-02	1.79000E 04	6.11600E-03
12	2.42000E-02	1.79000E 04	6.11600E-03
13	2.64000E-02	1.79000E 04	6.11600E-03
14	2.86000E-02	1.79000E 04	6.11600E-03
15	3.08000E-02	1.79000E 04	6.11600E-03
16	3.30000E-02	1.79000E 04	6.11600E-03
17	3.52000E-02	1.79000E 04	6.11600E-03
18	3.74000E-02	1.79000E 04	6.11600E-03
19	3.96000E-02	1.79000E 04	6.11600E-03
20	4.18000E-02	1.79000E 04	6.11600E-03
21	4.40000E-02	1.79000E 04	6.11600E-03
22	4.62000E-02	1.79000E 04	6.11600E-03
23	4.84000E-02	1.79000E 04	6.11600E-03
24	5.06000E-02	1.79000E 04	6.11600E-03
25	5.28000E-02	1.79000E 04	6.11600E-03
26	5.50000E-02	1.79000E 04	6.11600E-03
27	5.72000E-02	1.79000E 04	6.11600E-03
28	5.94000E-02	1.79000E 04	6.11600E-03
29	6.16000E-02	1.79000E 04	6.11600E-03
30	6.38000E-02	1.79000E 04	6.11600E-03
31	6.60000E-02	1.79000E 04	6.11600E-03
32	6.82000E-02	1.79000E 04	6.11600E-03
33	7.04000E-02	1.79000E 04	6.11600E-03
34	7.26000E-02	1.79000E 04	6.11600E-03
35	7.48000E-02	1.79000E 04	6.11600E-03
36	7.70000E-02	1.79000E 04	6.11600E-03
37	7.92000E-02	1.79000E 04	6.11600E-03
38	8.14000E-02	1.79000E 04	6.11600E-03
39	8.36000E-02	1.79000E 04	6.11600E-03
40	8.58000E-02	1.79000E 04	6.11600E-03
41	8.80000E-02	1.79000E 04	6.11600E-03
42	9.02000E-02	1.79000E 04	6.11600E-03
43	9.24000E-02	1.79000E 04	6.11600E-03
44	9.46000E-02	1.79000E 04	6.11600E-03
45	9.68000E-02	1.79000E 04	6.11600E-03
46	9.90000E-02	1.79000E 04	6.11600E-03
47	1.01200E-01	1.79000E 04	6.11600E-03
48	1.03400E-01	1.79000E 04	6.11600E-03
49	1.05600E-01	1.79000E 04	6.11600E-03
50	1.07800E-01	1.79000E 04	6.11600E-03

*** TEST PROBLEM NO. 3 *** TWO-WAVE EQUATION OF STATE *** PLATE SLAP

J	X	VELOCITY	ZONE MASS
51	1.10000E-01	1.79000E 04	6.11600E-03
52	1.12200E-01	1.79000E 04	6.11600E-03
53	1.14400E-01	1.79000E 04	6.11600E-03
54	1.16600E-01	1.79000E 04	6.11600E-03
55	1.18800E-01	1.79000E 04	6.11600E-03
56	1.21000E-01	1.79000E 04	6.11600E-03
57	1.23200E-01	1.79000E 04	6.11600E-03
58	1.25400E-01	1.79000E 04	6.11600E-03
59	1.27600E-01	1.79000E 04	6.11600E-03
60	1.29800E-01	1.79000E 04	6.11600E-03
61	1.32000E-01	1.79000E 04	6.11600E-03
62	1.34200E-01	1.79000E 04	6.11600E-03
63	1.36400E-01	1.79000E 04	6.11600E-03
64	1.38600E-01	1.79000E 04	6.11600E-03
65	1.40800E-01	1.79000E 04	6.11600E-03
66	1.43000E-01	1.79000E 04	6.11600E-03
67	1.45200E-01	1.79000E 04	6.11600E-03
68	1.47400E-01	1.79000E 04	6.11600E-03
69	1.49600E-01	1.79000E 04	6.11600E-03
70	1.51800E-01	1.79000E 04	6.11600E-03
71	1.54000E-01	1.79000E 04	6.11600E-03
72	1.56200E-01	1.79000E 04	6.11600E-03
73	1.58400E-01	1.79000E 04	6.11600E-03
74	1.60600E-01	1.79000E 04	6.11600E-03
75	1.62800E-01	1.79000E 04	6.11600E-03
76	1.65000E-01	1.79000E 04	6.11600E-03
77	1.67200E-01	1.79000E 04	6.11600E-03
78	1.69400E-01	1.79000E 04	6.11600E-03
79	1.71600E-01	1.79000E 04	6.11600E-03
80	1.73800E-01	1.79000E 04	6.11600E-03
81	1.76000E-01	1.79000E 04	6.11600E-03
82	1.78200E-01	1.79000E 04	6.11600E-03
83	1.80400E-01	1.79000E 04	6.11600E-03
84	1.82600E-01	1.79000E 04	6.11600E-03
85	1.84800E-01	1.79000E 04	6.11600E-03
86	1.87000E-01	1.79000E 04	6.11600E-03
87	1.89200E-01	1.79000E 04	6.11600E-03
88	1.91400E-01	1.79000E 04	6.11600E-03
89	1.93600E-01	1.79000E 04	6.11600E-03
90	1.95800E-01	1.79000E 04	6.11600E-03
91	1.98000E-01	1.79000E 04	6.11600E-03
92	2.00200E-01	1.79000E 04	6.11600E-03
93	2.02400E-01	1.79000E 04	6.11600E-03
94	2.04600E-01	1.79000E 04	6.11600E-03
95	2.06800E-01	1.79000E 04	6.11600E-03
96	2.09000E-01	1.79000E 04	6.11600E-03
97	2.11200E-01	1.79000E 04	6.11600E-03
98	2.13400E-01	1.79000E 04	6.11600E-03
99	2.15600E-01	1.79000E 04	6.11600E-03
100	2.17800E-01	1.79000E 04	6.11600E-03

*** TEST PROBLEM NO. 3 *** TWO-WAVE EQUATION OF STATE *** PLATE SLAP

J	X	VELOCITY	ZONE MASS
101	2.23000E-01	1.34250E 04	6.11600E-03
102	2.22288E-01	8.95000E 03	6.36064E-03
103	2.24668E-01	4.47500E 03	6.61507E-03
104	2.27142E-01	0	6.87967E-03

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
25	4.7198E-10	7.9497E-11	106	101	9.9088E 08	2.2001E-01	1.1065E 04	1.3381E-02	1.1065E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
1.1167E-05	1.1167E-05	2.3488E 00	0	1.1065E 04	3.4485E-06	2.2001E-01	8.4802E-01	1.1820E 00	201

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
50	2.5444E-08	1.8651E-09	114	103	1.4186E 10	2.2486E-01	1.0974E 04	9.0577E 01	1.1065E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.8000E-07	7.7362E-07	2.3528E 00	0	1.1065E 04	4.5546E-04	2.2026E-01	8.4802E-01	1.1820E 00	201

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
51	2.7309E-08	1.8670E-09	115	103	1.4187E 10	2.2487E-01	1.0954E 04	1.1114E 02	1.1065E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.7991E-07	7.7207E-07	2.3528E 00	0	1.1065E 04	4.8883E-04	2.2028E-01	8.4802E-01	1.1820E 00	201
2.731E-08	51	46	69						

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
51	2.7309E-08	1.8670E-09	69	57	1.4187E 10	2.2487E-01	1.0954E 04	1.1114E 02	1.1065E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.7991E-07	7.7207E-07	2.3526E 00	0	1.1065E 04	4.8883E-04	2.2028E 01	8.4802E-01	1.1820E 00	155

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
75	7.9672E-08	2.2119E-09	79	59	1.4425E 10	2.3031E-01	1.0368E 04	6.9712E 02	1.1065E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.6707E-07	7.1874E-07	2.3529E 00	0	1.1065E 04	1.4261E-03	2.2075E-01	8.4802E-01	1.1820E 00	155

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
100	1.3684E-07	2.3944E-09	87	69	1.4349E 10	2.6245E-01	1.0475E 04	5.8966E 02	1.1065E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.7114E-07	7.3005E-07	2.3532E 00	0	1.1065E 04	2.4495E-03	2.2126E-01	8.4802E-01	1.1820E 00	155

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
125	2.0342E-07	2.6569E-09	93	77	1.4298E 10	2.9897E-01	1.0564E 04	5.0080E 02	1.1065E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.7385E-07	7.3883E-07	2.3536E 00	0	1.1065E 04	3.6413E-03	2.2186E-01	8.4802E-01	1.1820E 00	155

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
150	2.7336E-07	2.8567E-09	99	83	1.4264E 10	3.3499E-01	1.0571E 04	4.9390E 02	1.1065E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.7574E-07	7.4111E-07	2.3538E 00	0	1.1065E 04	4.8931E-03	2.2248E-01	8.4802E-01	1.1820E 00	155

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
152	2.7823E-07	2.8667E-09	99	83	1.4261E 10	3.3504E-01	1.0513E 04	5.5228E 02	1.1065E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.7586E-07	7.3714E-07	2.3535E 00	0	1.1065E 04	4.9803E-03	2.2253E-01	8.4802E-01	1.1820E 00	155
2.782E-07	152	34	65						

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
152	2.7823E-07	2.8667E-09	65	49	1.4261E 10	3.3504E-01	1.0513E 04	5.5228E 02	1.1065E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.7586E-07	7.3714E-07	2.3527E 00	0	1.1065E 04	4.9803E-03	2.2253E-01	8.4802E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
175	3.2447E-07	1.9101E-09	68	52	1.4237E 10	3.5653E-01	1.0455E 04	6.0945E 03	1.1065E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.7721E-07	7.3439E-07	2.3517E 00	0	1.1065E 04	5.7980E-03	2.2294E-01	8.4802E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
200	3.8108E-07	2.8654E-09	71	22	1.4226E 10	1.3901E-01	4.2465E 03	5.8184E 03	1.1065E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.7779E-07	2.9850E-07	2.3518E 00	0	1.1065E 04	6.5634E-03	2.2345E-01	8.4802E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
225	4.3673E-07	2.8649E-09	74	25	1.4219E 10	1.6549E-01	4.1142E 03	6.9508E 03	1.1065E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.7816E-07	2.8934E-07	2.3491E 00	0	1.1065E 04	6.9449E-03	2.2394E-01	8.4802E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
250	4.9869E-07	1.9111E-09	77	29	1.4216E 10	2.0068E-01	3.8310E 03	7.2341E 03	1.1065E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.7836E-07	2.6949E-07	2.3482E 00	-1.0311E-01	1.1065E 04	6.9904E-03	2.2450E-01	8.4802E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
275	5.5723E-07	2.8662E-09	79	35	1.4213E 10	2.2961E-01	3.7275E 03	7.3439E 03	1.1071E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.7896E-07	2.6226E-07	2.3480E 00	-7.6949E 00	1.1073E 04	6.9879E-03	2.2502E-01	8.4802E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
300	6.1329E-07	2.2931E-09	82	40	1.4212E 10	2.5936E-01	3.9070E 03	7.1692E 03	1.1076E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.7936E-07	2.7491E-07	2.3478E 00	-1.1212E 01	1.1076E 04	6.9947E-03	2.2552E-01	8.4802E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
325	6.7554E-07	2.8668E-09	86	44	1.4208E 10	2.9313E-01	4.0581E 03	7.0240E 03	1.1082E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.7997E-07	2.8562E-07	2.3476E 00	-1.6223E 01	1.1081E 04	6.9814E-03	2.2608E-01	8.4802E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
350	7.3532E-07	2.7520E-09	90	47	1.4205E 10	3.2639E-01	3.7152E 03	7.3629E 03	1.1085E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.8036E-07	2.6154E-07	2.3474E 00	-2.0994E 01	1.1086E 04	6.9792E-03	2.2659E-01	8.4802E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
375	8.0053E-07	2.8594E-09	94	52	1.4203E 10	3.6079E-01	3.7859E 03	7.3128E 03	1.1093E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.8143E-07	2.6656E-07	2.3479E 00	-3.7061E 01	1.1102E 04	6.9766E-03	2.2698E-01	8.4802E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
400	8.5479E-07	2.7509E-09	97	56	1.4201E 10	3.9352E-01	3.9645E 03	7.1473E 03	1.1112E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.8245E-07	2.7916E-07	2.3471E 00	-4.4685E 01	1.1110E 04	6.9746E-03	2.2698E-01	8.4803E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
425	9.1265E-07	1.9110E-09	101	59	1.4200E 10	4.2179E-01	3.9667E 03	7.1691E 03	1.1136E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.8422E-07	2.7935E-07	2.3460E 00	-5.9131E 01	1.1124E 04	6.9722E-03	2.2698E-01	8.4804E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
450	9.7051E-07	1.9111E-09	104	62	1.4198E 10	4.5349E-01	4.0805E 03	7.3845E 03	1.1145E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.8638E-07	2.8740E-07	2.3456E 00	-7.9253E 01	1.1144E 04	6.9697E-03	2.2697E-01	8.4803E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
475	1.0268E-06	1.9111E-09	108	65	1.4196E 10	4.5909E-01	4.1064E 03	7.4653E 03	1.1172E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.8699E-07	3.0336E-07	2.3473E 00	-9.7331E 01	1.1162E 04	6.9668E-03	2.2697E-01	8.4821E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
500	1.0791E-06	1.9109E-09	111	67	1.4193E 10	5.1536E-01	4.3350E 03	6.8572E 03	1.1192E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.8856E-07	3.0543E-07	2.3467E 00	-1.1225E 02	1.1177E 04	6.9629E-03	2.2697E-01	8.4840E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
525	1.1281E-06	2.7514E-09	114	68	1.4181E 10	5.2948E-01	4.0625E 03	7.1467E 03	1.1209E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.9044E-07	2.8648E-07	2.3460E 00	-1.2173E 02	1.1197E 04	6.9607E-03	2.2696E-01	8.4867E-01	1.1820E 00	121

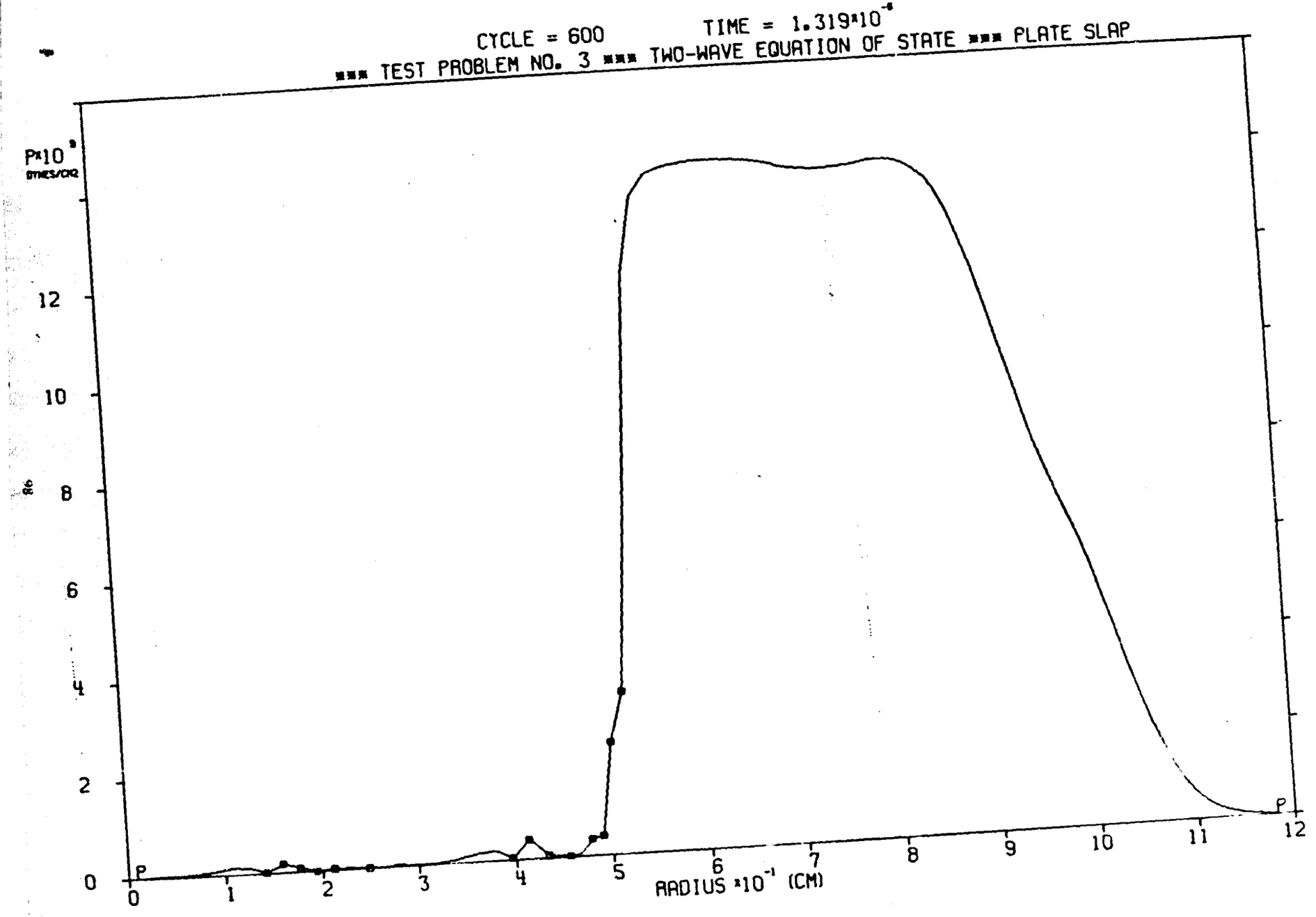
CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
550	1.1842E-06	1.9114E-09	118	70	1.4142E 10	5.5900E-01	4.1267E 03	7.0986E 03	1.1225E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.9373E-07	2.9180E-07	2.3451E 00	-1.3342E 02	1.1196E 04	6.9622E-03	2.2696E-01	8.4893E-01	1.1820E 00	121

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
554	1.1918E-06	1.9109E-09	119	71	1.4135E 10	5.7446E-01	4.4535E 03	6.7583E 03	1.1212E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.9321E-07	3.1507E-07	2.3452E 00	-1.4710E 02	1.1212E 04	6.9620E-03	2.2696E-01	8.4898E-01	1.1820E 00	121
1.192E-06	554	-11	129						
1.192E-06	554	30	99						

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
554	1.1918E-06	1.9109E-09	99	41	1.4135E 10	5.7446E-01	4.4456E 03	6.7583E 03	1.1205E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.9273E-07	3.1459E-07	2.3378E 00	-1.0533E 02	1.1168E 04	6.9620E-03	2.2696E-01	8.4898E-01	1.1820E 00	102

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
575	1.2503E-06	2.8661E-09	101	43	1.4123E 10	6.0763E-01	4.5852E 03	6.6212E 03	1.1206E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.9350E-07	3.2467E-07	2.3396E 00	-1.3716E 02	1.1200E 04	6.9592E-03	2.2696E-01	8.4940E-01	1.1820E 00	102

CYCLE	TIME	DTNH	JSTAR	JPMAX	PMAX	XJPMAX	MVPULSE	MVPREC	MOMENTUM
600	1.3187E-06	2.8667E-09	101	45	1.4052E 10	6.4356E-01	4.5625E 03	6.6227E 03	1.1215E 04
DTPP	DTPULS	ETOTAL	EMVNEG	EMVPOS	L-BOUND	X(JBND1)	X(JBND2)	R-BOUND	JFIN
7.9952E-07	3.2468E-07	2.3384E 00	-1.5586E 02	1.1219E 04	6.9552E-03	2.2696E-01	8.4998E-01	1.1820E 00	102


CYCLE = 600
TIME = 1.319*10^-6
*** TEST PROBLEM NO. 3 *** TWO-WAVE EQUATION OF STATE *** PLATE SLAP
P*10^9
DYNES/CM2
12
10
8
6
4
2
0
P
0
1
2
3
4
5
6
7
8
9
10
11
12
P
RADIUS *10^-1 (CM)

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13. ABSTRACT

The report describes the one-dimensional Lagrangian hydrodynamics computer program, PUFF. The code is used primarily in the study of X-ray effects. In the past year, it has been extensively revised and is now quite different from versions used outside the Air Force Weapons Laboratory. The major calculations in each subroutine are explained with a complete description of all input-output variables. Sample problems with the appropriate data deck are included to allow a user to become familiar with data arrangement and to check the program on his computer.

DD FORM 1 JAN 64 1473

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14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Hydrodynamics Calculations One-dimensional Fluid Flow X-ray Effects Code One-dimensional Hydrodynamic Program PUFF Code - Energy deposition P PUFF Code - Plate slap						

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Research and Technology Division
AIR FORCE WEAPONS LABORATORY
Air Force Systems Command
Kirtland Air Force Base
New Mexico

6 July 1965

ERRATA

AFWL TR-65-24 — THE PUFF AND P PUFF COMPUTER PROGRAMS
Unclassified report, March 1965

When the P PUFF Fortran listing is updated with the Addendum changes, JPMAXI must be added to each of the COMMON blocks.

On page 18 the 5th variable defined should read NRZC instead of NRZ.

Authority:

RALPH H. PENNINGTON
Lt Colonel, USAF
2 July 1965

C. W. HAIG
Chief, Reports and Data Branch
Technical Information Division

Research and Technology Division
AIR FORCE WEAPONS LABORATORY
Air Force Systems Command
Kirtland Air Force Base
New Mexico

28 May 1965

ADDENDUM

AFWL TR-65-24 THE PUFF AND P PUFF COMPUTER PROGRAMS

This addendum is to notify users of recent improvements and changes to the PUFF and P PUFF programs and to correct two minor discrepancies in AFWL TR-65-24.

The improvements are related mostly to REZONE and should help to improve pulse resolution in poorly zoned problems. The major changes are found in the Equation of State Subroutine. The solid phase equation of state is now fit to raw Hugoniot data.

These additions will affect the solutions to the three sample problems slightly. If one wishes to check the code conversion to his computer, we suggest adding the following changes after the initial conversion has been checked.

On page 23, delete the first statement past statement number 17, SSCK=1..

On page 24, delete statement number 53 and substitute the following three statements:

```
    GO TO 531
 53 SSCK=1.
531 DTN=DTNH .
```

On page 31, change the first statement before statment number 2,

```
IF(JPMAX-JZPUL-JRZL-JPMAXI) 87, 87, 2
```

to read

```
IF(JPMAX-JZPUL-JPMAXI) 87, 87, 2 .
```

On page 33, delete statement number 50 and one statement past, JRZV=1 and MRZ=1. Number the next statement, JFINO=JFIN, 50; 50 JFINO=JFIN.

Change the second statement on page 34 to M=1 .

On page 34, delete the first statement past statement number 52 and substitute the following four statements:

```
      IF(TIME-SDUR) 520, 530, 530
  520 KRZ=1
      GO TO 53
  530 IF(JPLC-JV-JRZL) 53, 53, 60 .
```

On page 34, change the first statement before statement number 56 to read

```
      IF(JPLC+1-JBND(MM)) 57, 56, 56 .
```

On page 35, delete the second statement past statement number 86, NRZ=N, and substitute the following three statements:

```
      IF(JPMAXI) 860, 860, 870
  860 JPMAXI=0
  870 NRZ=N .
```

On page 38, change statement number 7 and one statement past to read

```
    7 TS2=(CUSP1(M)+((CUSPS(M)*ARG+CUSPD(M))*ARG
        +CUSPC(M))*ARG)*(1.-(CUSPG(M)* EMU)/2.)
      P1=TS2+CUSPG(M)*D*E1,
```

and change statement number 8 to read

```
    8 TS2 = ((EQSTS(M)*EMU+EQSTD(M))*EMU+EQSTC(M))
          *EMU*(1.-(EQSTG(M)*EMU)/2.) .
```

On page 41, delete statement number 20 and substitute the following three statements:

```
   20  IF(N-1) 200, 200, 210
  200  JPMAXI=JPMAX+10
  210  IF(J-JSTAR) 22, 21, 21 .
```

On page 44, change the second statement past statement number 31, NRZ=-50, to read NRZ=50.

On page 46, change the first statement before statement number 2 to read

```
      IF(JPMAX-JPMAXI) 85, 85, 2 .
```

On page 48, change the first statment before statement 54 to read

```
      IF(JPLC+1-JBND(MM))55, 54, 54 .
```

On page 50, delete the first statement past statement number 84, NRZ=N, and substitute the following four statements:

```
      JPMAXI=JPMAXI-JRZ
      IF(JPMAXI) 840, 840, 850
  840 JPMAXI=0
  850 NRZ=N .
```

On page 53, delete the first executable statement, ENU=D/RHO(M), and substitute the following five statements:

```
      IF(E1) 10, 10, 20
   10 E1=0.
      P1=0.
      GO TO 9
   20 ENU=D/RHO(M) .
```

Also, there are two more changes on page 53. Statement number 7 and one statment past are changed to

```
    7 TS2=(CUSP1(M)+((CUSPS(M)*ARG+CUSPD(M))*ARG
        +CUSPC(M))*ARG)*(1.-(CUSPG(M)* EMU)/2.)
      P1=TS2+CUSPG(M)*D*E1,
```

and statement number 8 is changed to

```
    8 TS2=((EQSTS(M)*EMU+EQSTD(M))*EMU+EQSTC(M))*EMU*(1.-(EQSTG(M)*EMU)/2.).
```

This addendum has been reviewed and is approved.

Richard N. Brodie
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